

Complete Gardening in India

Revised and Enlarged Third Edition
Profusely Illustrated

BY

K. S. GOPALASWAMIENGAR, B.A., B.L., F.R.H.S.

Author of "Cultivation of Bulbous Plants in India"
and "Gardening Notes" in "The Hindu"

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H. S. GOPALASWAMIENGAR

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Foreword to the Third Edition

Interest in gardens and garden plants has been increasing considerably in recent years. This is a matter for gratification because there are few things in life which can give so much pleasure as gardening, whether one does it on a small-scale or a large-scale. But to assist the gardener in India the number of books which contain the large amount of information sought for by people with gardens, in a form which can easily be absorbed, is very small indeed. Shri K. S. Gopalaswamiengar's book is one of these few and it ranks among the best of them. A new edition is therefore to be greatly welcomed especially because his son, Shri G. Kasturi Rangan, who has prepared this, has added to it his own very wide experience of modern varieties. He has made substantial additions of subjects as roses in which he is now a recognised authority.

The arrangement of the book is very appropriate, the first part dealing with general subjects such as how to plan a garden, how to handle soils and water, and other such important matters. The second half of the book takes up groups of plants such as trees, palms, shrubs, climbers, roses, and so on. I have personally found that the wealth of information given is accurate and can be applied to a large range of conditions in India. Naturally, in one volume, one cannot cover all aspects of gardening nor cater for all conditions; for that perhaps encyclopaedia is necessary. The average gardener, however, does not want to be rushing to an encyclopaedia all the time, and a handy volume like the present one is just what he needs. Because new varieties are added every year in the case of certain plants, specially roses, and because the new ways of preventing or eradicating diseases and pests become available with the advance of scientific knowledge in these and other fields, revised editions of books become a necessity. I am quite sure that the latest

Foreword to the Second Edition

It is with sincere pleasure that I comply with Mr. Gopalaswamiengar's request to write this foreword introducing the second edition of his book, *Complete Gardening in India*.

The enthusiastic reception of the first edition written by an amateur for the benefit of amateurs was really remarkable for the appreciative opinion not only of the Press throughout India, Burma and Ceylon but also of the public generally; and the first edition was sold out in an unusually short time.

I visited many of the Provincial Towns and larger Indian States during the last 15 years on professional work and everywhere noted the persistent demand for the book; and even when at home, many visitors to Bangalore called on me to introduce them to Mr. Gopalaswamiengar and to see his nursery in the hope of getting a copy of his book.

Unfortunately, Mr. Gopalaswamiengar was not able owing to serious illness and other difficulties to publish this second and enlarged edition till now. The book is richer in knowledge gained by added experience and I am confident that it will be found even more useful than the last edition.

I note that the chapters on Fruits and Vegetables have been greatly enlarged and will be especially useful to garden owners in view of the Grow More Food campaign.

I am quite at one with Mr. Gopalaswamiengar that he has retained the original title of the book notwithstanding that old India has been partitioned, for Pakistan will ipso facto come into the book's orbit of usefulness even as Burma and Ceylon do now. I wish it all success.

G. H. KRUMBIEGEL, F.R.S.H.
Director of Horticulture in Mysore (Retd.)

Preface to the Third Edition

The Second revised edition of this book printed in 1953, was received better than the First edition in view of the additional information carried in it. The author (Sri K. S. Gopalaswamiengar), my father, passed away in August 1955. The Second edition ran out of stock in 1960. From then on efforts were made to bring out the Third and enlarged edition and it has materialised only now.

The book has been revised again giving useful additional information wherever necessary. The Chapter on Roses, the queen of flowers, has been completely re-written, with the knowledge I have acquired as one of the leading Rose growers in the country. In my effort to bring out this edition I was helped to a great extent by Dr. B. P. Pal, Dr. M. H. Marigowda and Dr. K. S. Iyer and I am beholden to them.

Some of the blocks that went with the text in the Second edition have been taken out as there was a criticism to say that the blocks did not truly represent the specimen intended to be shown.

Seven colour plates have been introduced which, it is felt, would enhance the value of the book.

My thanks are due to Messrs Kalyan Printers, Bangalore, W. Q. Judge Press, Bangalore and Kalakshetra, Madras for the invaluable assistance rendered by them in bringing out this edition.

Bangalore, 1970

G. KASTURI RANGAN

Preface to the First Edition

For over six years, I have been contributing Notes on Gardening to *The Hindu*, Madras, and it has been suggested to me both by its Editor and numerous readers that a publication of the Notes, with incidental alterations, etc., in book form, with illustrations, would meet the much felt need of a large number of amateur gardeners. Nearly 25 years ago, my interest in gardening was first awakened by a clever and enthusiastic mali and my ardour for the hobby has all along been on the increase and in spite of professional and other engagements, I have been able to devote a good part of my leisure to gardening. As an amateur myself, I have experienced several doubts and difficulties in practical gardening, which I have had to solve myself, or get my gardening friends to solve for me, as there are very few exhaustive books on practical gardening applicable to the conditions in India.

As an active member of the Mysore Horticultural Society and as an exhibitor of plants and flowers in the several Shows held under its auspices, I have had the acquaintance of a number of gardening experts, with whom I have discussed and exchanged ideas. As a resident of Bangalore, which can claim to possess one of the Public Botanic Gardens in India, my opportunities for close observation and study of plants have been almost unlimited. I have had also the advantage of the use of the library in the Lalbagh, as also of the numerous excellent colour drawings, plates, and photographs there to which I have had free access. I have tried to embody in this book, all the results of my study, observation, and personal experience as a practical horticulturist for over twenty years and I am placing it before the public, in the language of an amateur, though I have had to use here and there technical words and phrases and quotations from several authors for better and more precise expression of ideas. A bibliography of books consulted is appended.

The book is divided into two parts. The First Part deals with the principles adopted in laying out gardens, the components of a modern garden and how they are formed, and several garden operations, such as the preparation of the soil and its enrichment with manures, propagation of plants, remedial and preventive measures to keep them free from pests and diseases—in fact, all the common tasks in the garden. The Second Part contains descriptive lists of select plants that are commonly grown in our gardens or are worth growing. Fuller lists are not given as the amateur may find it difficult to make a selection from very long lists. The more attractive species and varieties have been marked with asterisks. Comprehensive instructions are given in the introductory notes to the several lists in the Second Part and special points with reference to particular plants are emphasized under their respective names. The names in each list are arranged in the alphabetical order to facilitate reference. The National Order to which a plant belongs is given against its name and the species are arranged under the respective genera, to help the reader to have an idea of the common characteristics of the plants belonging to the same order or species.

The cultural directions given for the enumerated plants are those that are followed in Bangalore, about 3,000 feet above the sea level. They are however generally suited to all places in India with such variations as may be necessary for the varying altitudes, distances from the sea, amount of rainfall, climatic conditions, etc. The term low, medium and high elevations are used in the book with reference to places situated from the sea level to about 2,000 feet, from about 2,000-4,000 feet and from about 4,000-7,000 feet above the sea respectively.

Two chapters, one on the Kitchen Garden and other on Select Fruit Trees, have been added to make the volume a complete treatise on Home Gardening, as it is intended to be.

I am deeply indebted to the Editor and the Proprietors of *The Hindu* for the help rendered by them, but for which the publication of this book now would have been impossible. I am grateful to Mr. G. H. Krumbiegel, F.R.H.S., Director of Horticulture and Consulting (now retired) Architect to the Government of H. H. the Maharaja of Mysore for the encouragement he has been giving and the kindly interest he has been taking in all my efforts in writing and publishing this book. From Mr. Thomas Royer, the very capable Propagator in the Government Botanical Gardens, Lalbagh, Bangalore, I have received invaluable assistance and useful information in the preparation of this book. Mr. M. K. Sitharam Chetty, L.Ag., Officiating Superintendent of Government Botanical Gardens in Mysore, as also Mr. L. Narayana Rao, M.Sc., Assistant Professor of Botany in the Central College, Bangalore, have given me valuable help and my thanks are due to all of them. I must also thank Mr. H. C. Javaraya, L.Ag., F.R.H.S., till lately the Superintendent of the Government Botanical Gardens in Mysore and Senior Marketing Officer in the Government of India, for permitting me the use of the photos in Lalbagh for making some half-tones for this book and Mr. T. S. Dandapani Iyer, B.A., B.L. Art Editor, Hindu Office, Madras, for his help in the preparation of all the blocks for illustrations.

I should be failing in my duty if I fail to express my sincere thanks to my friend, Mr. A. Nagaraja Rao, B.A., B.L. for assisting me in correcting the proofs and to the Printers, The Huxley Press, Madras, who have shown the utmost patience and courtesy in incorporating the several alterations and corrections through the several stages of proofs.

Bangalore, 1935

K. S. GOPALASWAMIENGAR.

Preface to the Second Edition

I am happy to say that the First Edition of this book was very well received and has established a unique reputation for itself. I am bringing out this Second Edition to meet the persistent demand for the book. I have completely revised the book. The last two chapters, on Vegetables and Fruits in particular, have been practically rewritten considerably enlarging them with fresh matter.

I have retained the general treatment of the subject as indicated in the Preface to the First Edition.

The drawings for the illustrations in the First Edition of the book were made by Sri B. Kesar Singh A.R.P.S. to whom my thanks are due. Most of the half-tone illustrations on art paper are from photographs of plants from my own garden and nursery. I am obliged to Messrs M. Oblappa Brothers, Nurserymen, Bangalore for some blocks printed in the body of the book and for the colour block of Roses.

I am deeply grateful to my friend, Sri R. V. S. Manian, of *The Mail*, for all the help rendered in bringing out this publication—photographing many of the subjects, and arranging the details of production.

I am thankful to The Hosali Press, Bangalore, for their uniform courtesy and attention.

Bangalore, 1953

K. S. GOPALASWAMIENGAR.

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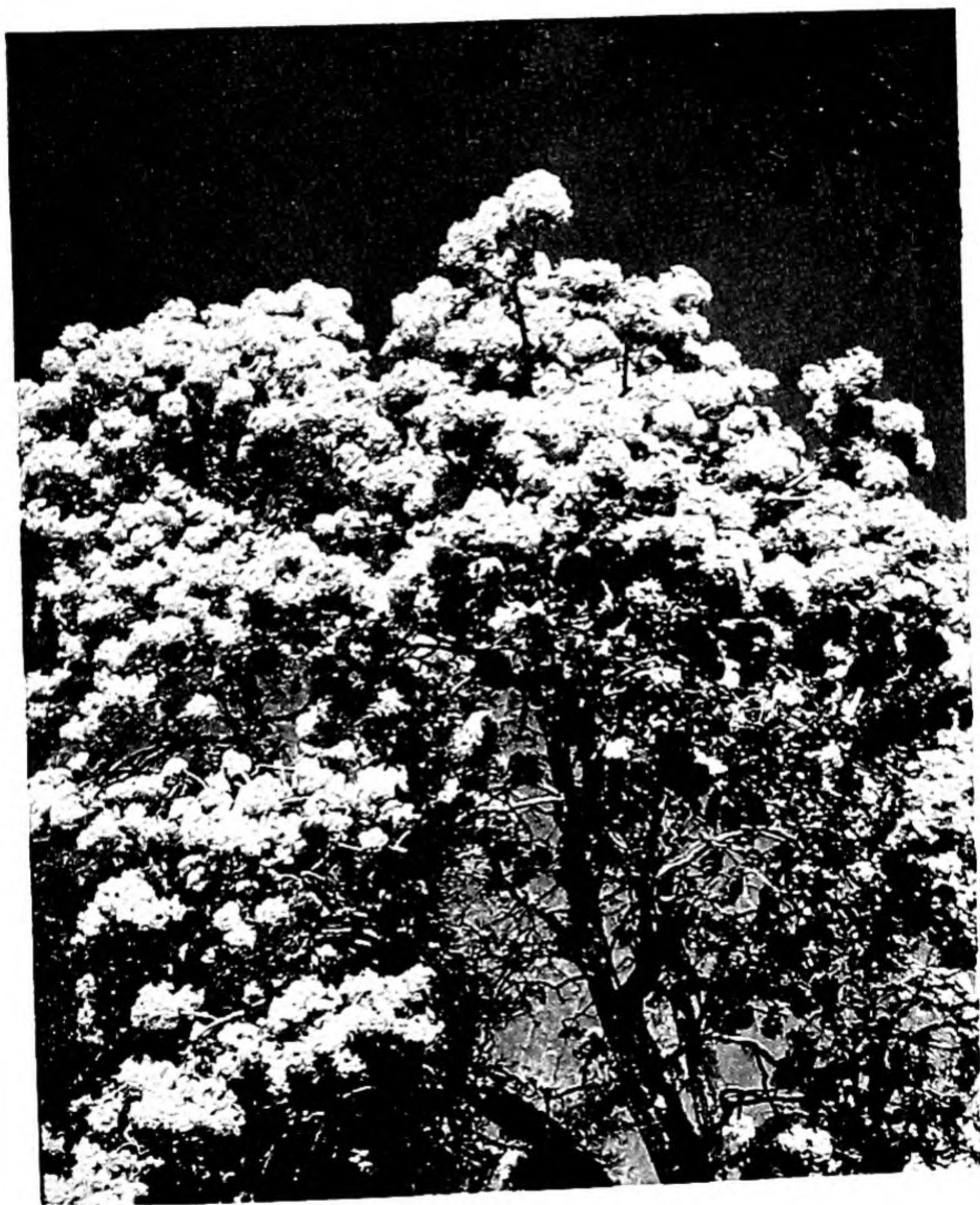


Plate 1 : CEBUIBIA ARGENTIA

CHAPTER I

GARDENING

Few avocations afford so much pleasure as gardening, whether taken as a hobby or as a business. "Gardening is", as Lord Bacon tells us, "the purest of human pleasures, the greatest refreshment to the spirit of man." Dean Hole, a great cleric, scholar and enthusiast in horticulture, in his *A Book About the Garden*, asks himself the question, which, of all the amusements and recreations of life, brings the longest and the largest happiness. He discusses the relative merits of several of them such as shooting, hunting, fishing, boating, racing, cricket, billiards, tennis, and concludes "All English sports and games I have loved and love and they satisfied not my present need." And, of gardening, he says, it gives "something more continuous than these—something which may occupy the thoughts and employ the actions of my leisure not in summer only, as in cricket, not in winter only, as the chase, but alike in every season of the year; and more than this, through all the different phases of my life—youth, manhood, and old age." He continues:—"Every day brings to a gardener its special interests. There is always something worthy of his care and admiration, some new development of beauty, some fresh design to execute, some lesson to learn, some genial work to do.....And, not only is the gardener's happiness in its duration sure, but it is in its peculiar essence, of a very sweet and gracious quality. It ministers health to the body. It ministers health to the mind. It brings pure air to the lungs and pure reverent thoughts to the heart. It makes us love our home, content and satisfied with those pleasures which neither sting nor pall; and yet when we leave our home, it follows us where-soever we go. As

'All places which the eye of Heaven visits
Are to a wise man ports and havens,'

so in all gardens, and in all gardeners, we find a home and brothers. There is always a welcome, always a sympathy....."

Gardening happens to be one of those luxuries that is not restricted to the upper classes. The wealthy may spend fortunes on conservatories, extensive lawns, costly adornments and rare specimens, while the poor may have about their houses only a few plants. But still, the enjoyment that each derives may be the same. The garden makes the home dear to each of them, and helps them to be content by satisfaction ever new.

Some maintain gardens just because they think it is the fashion to do so, and leave everything to *malis*, taking no personal interest themselves. There are others however, who maintain gardens, because of their true love of plants and of the beautiful; they tend, water, train the plants, protect them from inclemencies of weather and carefully watch them grow. It is the latter class of persons who enjoy the happiness of gardens and not those who keep them just because their neighbours also own gardens.

As things are at present, many a house-owner does not have a garden and if he has one, he often does not know when and how to sow a seed or how to plant a tree, and he is entirely at the mercy of the *mali*. This is to a great extent due to the fact that no earnest endeavour is made in our schools to encourage in children nature study and æsthetic taste. Horticultural instruction in our schools would largely add to the comforts of society as a whole, because children of to-day may some day have gardens of their own.

Horticultural societies should be formed with branches working in each town and village. They would promote and stimulate gardening interest and afford opportunities for appreciating the beauty of things pleasant to the eye and the utility of things good for food, by arranging shows and garden competitions. Tangible results could be obtained by issuing bulletins written in simple language explaining and expounding the science of gardening to laymen and women. In collaboration with educational authorities such societies might arrange for lantern lectures on various subjects and hold demonstrations for the benefit of the younger generation and thus kindle that spark of love for the beautiful which is latent in every child. In places which are fortunate in

possessing public gardens, children might be taken round, every now and then, so that they may watch and observe Nature's beauties. If only gardens are laid out in the premises of our educational institutions and the young are taught and allowed to work in them and reap their own harvests, we will have, in the course of a single generation, 'very few idlers who won't have gardens and very few ignorant men and women who won't know how to use them'.

CHAPTER II

PLANT LIFE

Unit of life, the cell : Life, in its simplest form, exists in a cell, a microscopic or minute body consisting of protoplasm—a jelly-like substance pulsating with life and usually protected

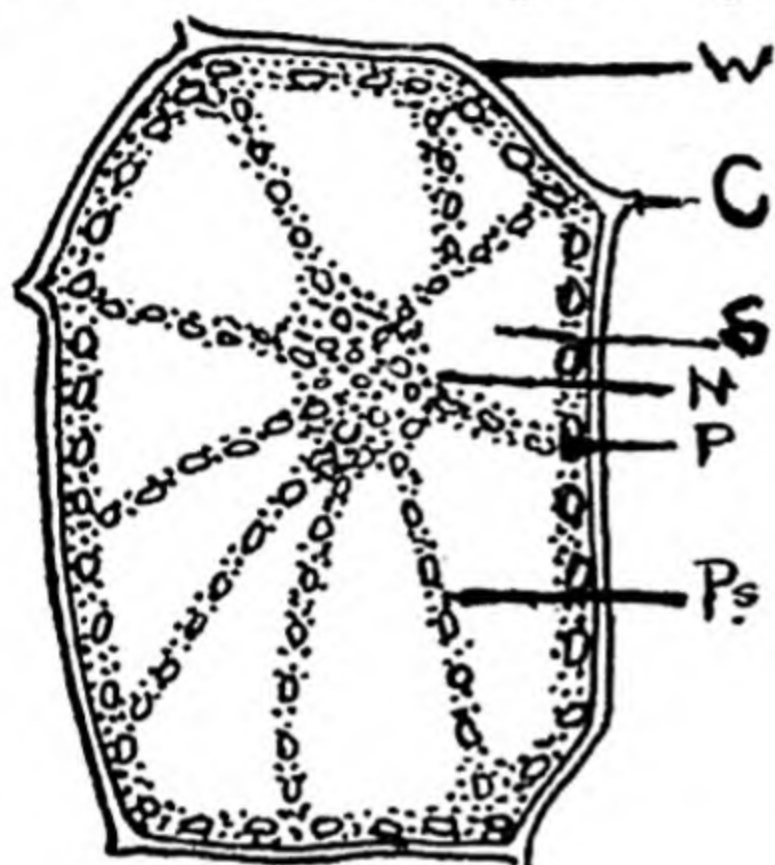


Fig. 1. A cell.

W = Cell wall.

C = Protoplasm.

S = Sap cavity.

N = Nucleus.

P = Plastid, Chlorophyll
or Chromoplast.

Ps = Protoplasmic strand.

by a membranous covering. Some of the forms of life are indistinguishable as plants or animals and consist of single cells or aggregates of one kind of cell. They breathe, absorb food or manufacture it out of raw materials, grow, excrete waste matter and reproduce their kind.

Plant cell.—A typical plant cell consists of a *cell wall* enclosing a viscid albumen-like mass of *protoplasm*, which together with the denser and darker body called *nucleus* found in it, is responsible for the reproductive and other activities of the cell. A cavity or cavities (*vacuoles*) in the protoplasm

are filled with the *cell sap* consisting of salts, sugar and organic products that are made by the protoplasm or that go to make it. The cell walls contain minute holes through which is established a bond between adjoining cells. Certain minute hard particles, called *plastids*, are found embedded in the protoplasmic material. Some of these, acted on by light, produce the *chlorophyll* grains which impart the green colour to plants. Some others are coloured red or yellow and purple and cause the autumnal tints in leaves and the colours in fruits and flowers. Colours in plants are also produced by the colouring matter found in cell sap.

How plants are built up : In all the higher forms of plants, as in animals, the cells are bricks with which their bodies are built. Cells vary considerably in size and shape and unite in definite and peculiar ways forming various kinds of tissues performing well assigned functions in the organised state of the plant. Some kinds of tissue provide the *epidermis* or the skin for the parts of the plant ; some give rigidity and requisite strength to parts containing them ; some serve as *vessels* or tubes conveying liquid ingredients for elaboration into food and some to convey manufactured food to points of growth or to be stored. Different kinds of tissues are arranged in characteristic ways to form the several parts of plants.

Parts of an ordinary plant : Any ordinary plant with which we are familiar consists of four parts, *viz.*, roots, stems, leaves and flowers. The first three constitute the vegetative parts, and the flowers with the seeds constitute the reproductive part. Modifications of these different parts give rise to that diversity of plant life which so delight the horticulturist. Each of these parts has its own specific function to perform in the general scheme of plant life.

Root and its functions : Roots penetrate the soil and they are usually, though not always, under the ground. The main or primary or tip root of a plant is really a development of the

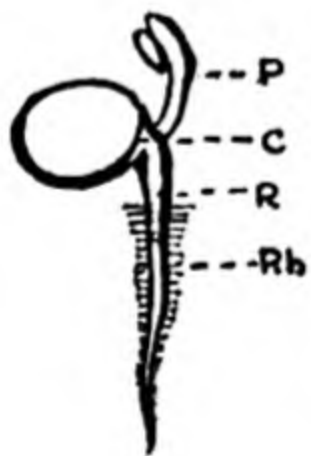


Fig. 2. Germinating seed.

P = Plumule.
C = Cotyledons with testa.
R = Radicle.
Rh = Root hairs.

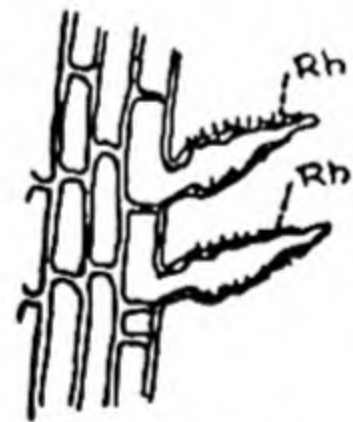


Fig. 3. Root hairs (several times enlarged). They are mere prolongations of cells forming the epidermis.

radicle which first emerges from the embryo of the seed. It divides itself as the plant grows and with its branches, the side or secondary roots, it serves to fix the plant in the soil. From the walls of the cells of the roots and their branches, as

they grow, emerge fragile, minute, invisible tubular structures called root-hairs which find their way through and cling to the particles of soil. Into the thin walls of these minute tubes water containing dissolved food passes from the soil and

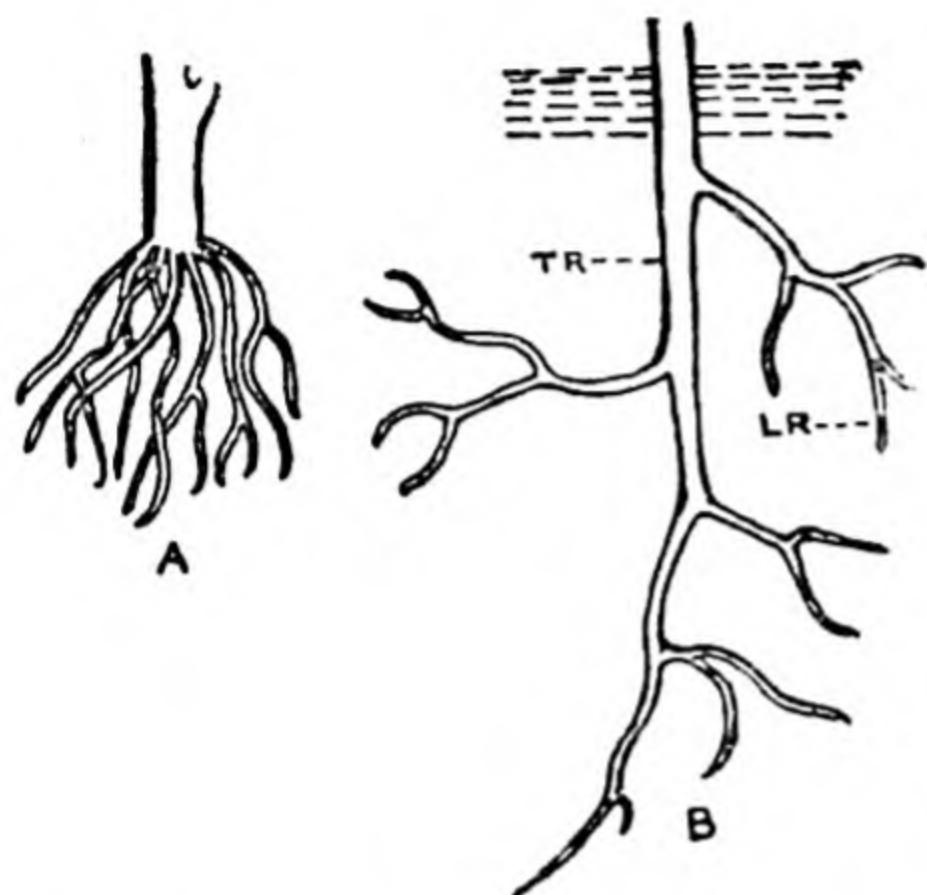


Fig. 4.

A. Fibrous root system in grass.

B. Root system of a tree or shrub.

TR = Tap root.

LR = Lateral or secondary root.

is then transmitted to the stem and leaves through the bigger channels in the roots and its branches. This explains the need for keeping the soil moist by supplying it with water and the careful handling of seedlings during transplanting to prevent injury to root-hairs. As the root and its branches grow and push through the soil, root-hairs die on their older portions and are replaced by new ones on their newer parts, which explore new areas for food. It is thus clear that the area which furnishes food and water to the plant is not exactly right under the stem but is away from it. This explains why big trees and shrubs are watered over an area away from the stem, as they can only then be benefited by the water supplied. In bulbous plants, the stem is underground and it is easily mistaken for the root or roots. Roots are usually brownish in colour although in some cases, as in Orchids, they are green.

There are several variations in the structure of the root. In some plants, adventitious roots are produced without any definite order from leaves, stem and roots and these are useful in different ways. They are aerial, as in Orchids and Aroids, and are useful for taking in moisture directly from the atmosphere; they are clinging, as in the Ivy, and serve to fasten the plants to supports; they are parasitic and penetrate the host plants robbing them of their food, as in Loranthes and Fungi.

This property of forming adventitious roots is taken advantage of in multiplying plants by cuttings and layering. In some plants as in the Radish, the primary root, and in some others as in the Dahlia and Asparagus, both the primary and secondary roots form thickened portions which serve as store houses of reserve food material for production of flowers and seeds during next season or year. Grasses and similar monocotyledons have a number of similar thread-like roots, called the *fibrous roots*, among which the primary root is not distinguishable. Such roots serve to bind earth and advantage is taken of this in planting grass on slopes of embankments to prevent erosion.

Stem and its functions : The stem is an essential part of the plant, which originates from the *plumule* which emerges from the seed germ on the side opposite to the radicle. It grows outward from the ground and bears the branches and the leaves, holding the latter up to light. The stem and its ramifications, the branches, connect the leaves, the flowers and the fruits with the roots. The stem varies in form and size considerably. Usually, it is green and soft in herbs and tender parts of plants. In shrubs and trees it is woody, brown and sturdy in matured parts where it develops a bark. Sometimes, as in the Cactus, the stem is green and fleshy and has the appearance of a leaf, performing functions similar to those of the leaf. In some other plants, the stem is underground, as in bulbous plants like the Lily, Arum, Onion and Canna and it then acts as a receptacle of reserve material and sends up aerial shoots bearing leaves and flowers. But all the morphological variations of the stem need not be noticed here as they belong entirely to the province of botany and do not come within the scope of this book. It may, in passing, however be mentioned, that it has an infinite variety of form ranging from the sturdy Ficus to a slender Grass and from the tuberous Potato to the leaf-like Cactus.

Structure of stem : The ground tissue of the stem is variously modified according to circumstances. Usually, the stem of a dicotyledonous tree consists of four general regions as will be seen by an examination of its cross-section :—(1) In the centre is the soft spongy substance called the *pith* which is

of small size. (2) Around the pith is the harder *wood* formed of strands of vascular tissue which gives rigidity to the plant and which is arranged in groups or bundles appearing in the form of rings in grown-up stems, each ring corresponding to one year's growth. (3) Surrounding the wood is a zone of delicate softer tissue of thin walled cells, usually colourless, called the *bast* or the *phloem*. (4) The outermost layer, the *bark*, is a composite structure, the thick *epidermis* (outer skin) of which protects all the inner parts. The *cambium* is a very thin layer of thin-walled soft cells situated between the wood and the phloem rings and forming a sort of continuous jacket surrounding woody portions of the tree from the tips of the branches to the tips of the roots. It is the most active or live portion of the stem, where growth takes place every year. It produces two sets of cells one thickening the interior wood

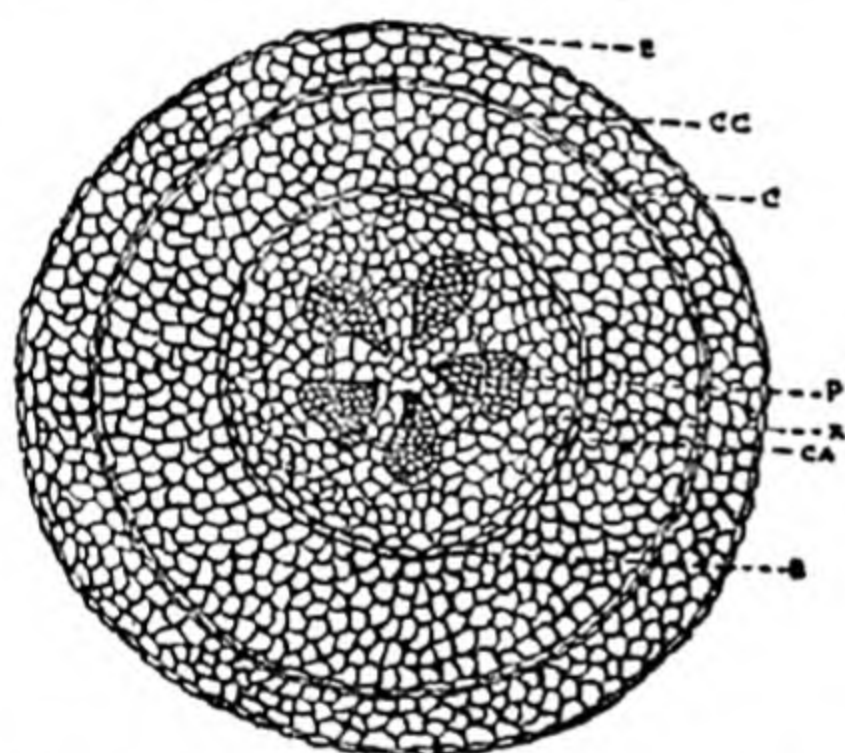


Fig. 5. Cross-section of a young dicot stem.

E = Epidermis.

CC = Cork cambium.

C = Cortex = the soft tissue between the epidermis and the endodermis.

P = Phloem = food conducting tubes.

X = Xylem = wood vessels or water conducting tubes.

CA = Cambium.

E = Endodermis = inner skin.

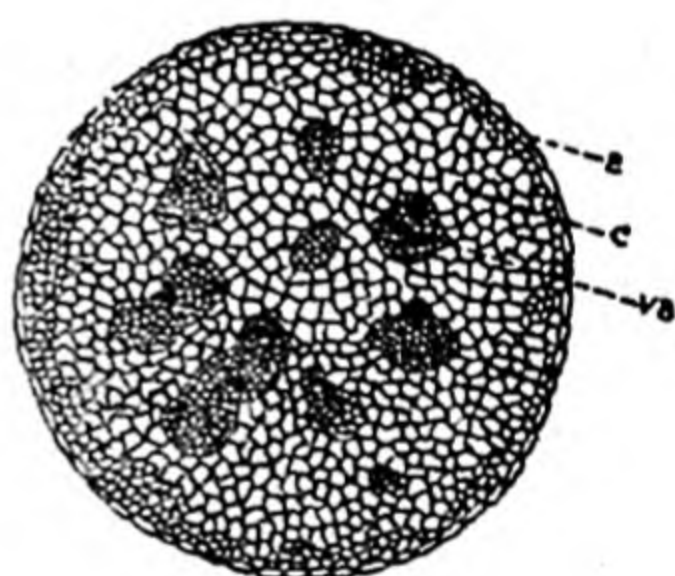


Fig. 6. Cross-section of a monocot stem.

E = Epidermis.

C = Cortex.

VB = Vascular bundle.

portion and the other set thickening the exterior phloem of the stem as well. As a result of this, the stem grows in thickness which naturally leads to the rupture of the epidermis. In

order to protect the plant under these conditions from the ravaging effects of other micro-organisms, *cork* is produced just below the surfaces of the epidermis by an active tissue called the *cork cambium*, not unlike the cambium referred to above. In budding and grafting operations, the cambiums of the stock and the scion (not the cork cambiums) are brought in contact with each other, so that the stock and the scion may unite, the cambium being the only active portion bringing about unification. In the stem of monocotyledonous plants, such as grasses and palms, there is no pith, there is no cambium, and the vascular bundles are not arranged in the form of a hollow cylinder but they are distributed in the growing tissue. As there is no cambium, there is no growth in the stem after the cells, fibres and vessels of which it is composed, have once reached their full size.

The stem, besides supporting the branches and leaves and spreading them out to air and light, serves as a food store for future use by the plant and provides the channels for the ascending sap from the roots to the leaves and the descending sap of elaborated food from the leaves to all parts of plants for their growth.

Leaf : Leaves are usually flat and have a unilateral symmetry. They may be very simple in shape or very elaborate and ornately cut. Usually, the *blade*, which is the essential part of the leaf, is attached to the stem by a leaf-stalk, which is called the *petiole*. Leaves are normally green in colour owing to the presence of green plastid, known as the chloroplast. In the case of highly coloured leaves, as in Crotons and Coleus other colouring matters present in their cells mask the colour of the chlorophyll. Morphologically, there are various modifications of leaves according to the functions they perform in different plants. In the Cactus for instance, the leaves are modified into thorns which protect them



Fig. 7. Leaf and its parts.

- L = Lamina or blade.
- M = Midrib.
- P = Petiole=leaf-stalk.
- B = Bud.
- S = Stipule.

from being eaten by animals, while the stem is green and fleshy and itself performs the normal work of leaves. In carnivorous plants, such as the *Drosera* and *Nepenthes*, the leaves serve as traps for insects upon which the plants feed. The tendril of the Pea is a modified leaf helping the plant to support itself.

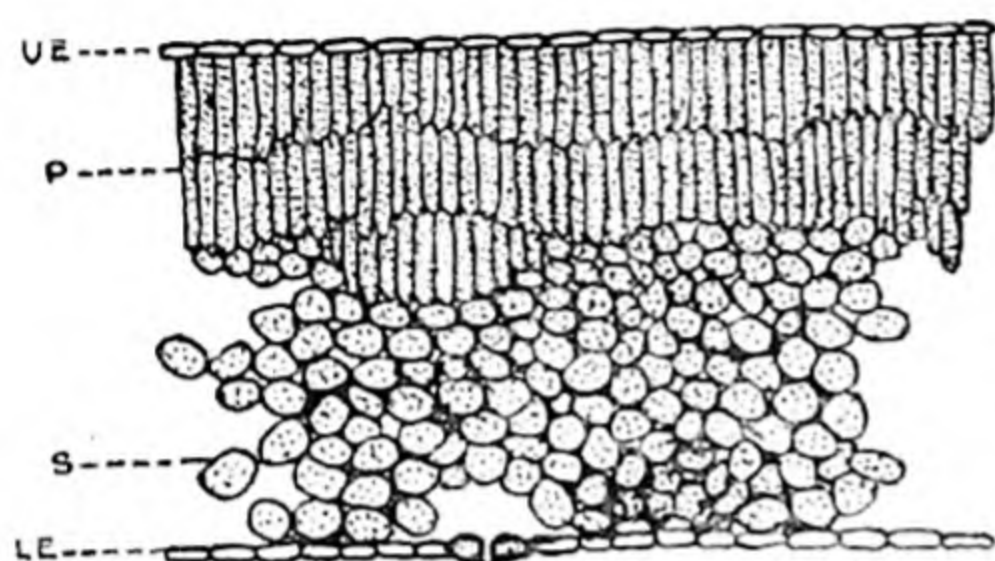


Fig. 8. I.
Vertical section of a leaf
(enlarged many times).

UE = Upper epidermis.
P = Palisade parenchyma
S = Spongy parenchyma
LE = Lower epidermis.

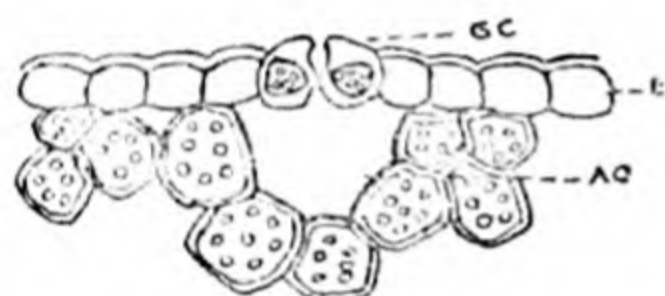


Fig. 8. II.
Section of leaf showing stomata.

GC = Guard cell = stomata.
E = Epidermis.
AC = Air cavity.

Structure of leaf : The leaf is covered by a thin epidermis made up of a layer of cells. Situated on the epidermis, more especially on the underside of the leaf, are the *stomata*, acting as the air passages to the interior of the leaf, putting the internal cells of the leaf into communication with the air outside. Between the upper and the lower layers of epidermal cells of the leaf is a mass of green tissue known as the *mesophyl*, which has the chloroplasts in it and makes up the body of the leaf. The lower layers of the mesophyl are spongy and the cells therein are irregular in form and loosely arranged to form air spaces between them. These spaces communicate with each other forming a labyrinthine system of air chambers throughout the spongy mesophyl. It is into this system of air chambers that the stomata open. The function of the stomata is to allow moisture to escape from the leaf in the process of transpiration and to allow air in, and carbon-dioxide out, during respiration. The veins and veinlets of the leaf are embedded in the mesophyl and they form the supporting

framework of the leaf and conduct material to and from the green working cells.

Flower and its parts : The flower, from the horticulturist's point of view, is the most attractive part in most plants. It is produced in the axil of a leaf or terminally at the end of a shoot. Botanically essential

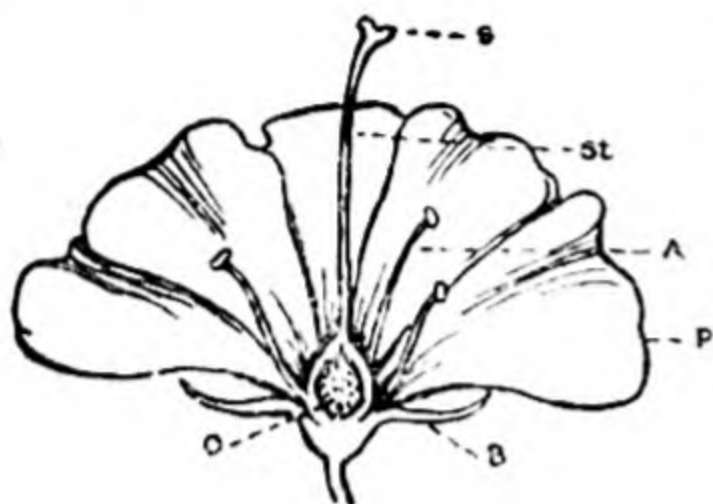


Fig. 9. Flower and its parts.

- S = Stigma.
- St = Style.
- A = Stamens
- P = Petals.
- O = Ovary.
- B = Sepals.

parts of the flower are the reproductive cells. The ornamental parts of the flower such as the petals, are intended solely for the protection and assistance of the generative cells. There are several modifications in the construction of the flower in different plants. An ordinary complete flower consists of four sets of leaves or organs, called the *calyx*, the *corolla*, the *stamens* and the *pistil*, respectively arranged in whorls one inside the other. The outermost leaves of a flower forming the *calyx* are usually of a strong structure and of a green or brown colour. In some flowers however, the calyx is as highly coloured and showy as the petals. The calyx may be composed of separate leaves, called *sepals*, or be united into a tube. The next circle of floral leaves forms the *corolla*. It serves to attract insects that help fertilization and protect the inner essential organs; *viz.*, the stamens and the pistil which contain the reproductive male and female cells respectively. The *corolla* may consist of separate leaves, called *petals*, or be united. There are endless modifications of the calyx and *corolla*, bearing an intimate relation to the methods of fertilization. The number of stamens vary from one to many in a flower. A stamen is usually made up of a stalk, which is called the *filament*, and a little lump at its top, which is called the *anther*. The anther contains powdery looking *pollen* grains, the male elements that fertilize the egg cells in the pistil, which occupies the centre of the flower. The *pistil* consists of a lower inflated portion called the *ovary*, a long stalk continuous with

the latter known as the *style* and a knob on its apex known as the *stigma*. When the ovary is cut across, it is seen to be composed of one or more modified leaves called the *carpels* which are folded together to form one or more compartments filled with one or more ovules. *Ovules* are unfertilised seeds which contain the female cells surrounded by one or two coats and are attached to the walls of the ovary, the part of attachment being called the *placenta*.

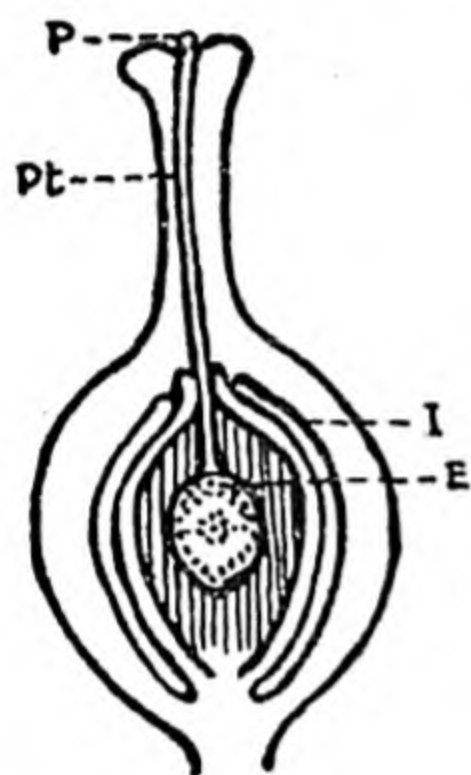


Fig. 10. Pollination.

P = Pollen grain.

Pt = Pollen tube.

I = Integument, becoming later on two seed coats, testa and tegmen.

E = Egg apparatus, consisting of the egg cell and its sister cells.

A *complete flower* is one that has all the parts it can have. An *incomplete flower* may have any of its part missing—calyx or corolla or both, or the stamen or the pistil. A flower having only the stamen and no pistil is called a male or *staminate flower*. A *pistillate flower* is one in which the stamens are absent.

Fertilization : The process by which the pollen, carried by an insect, wind, or any other agency from the stamen, is deposited on the stigma is known as *pollination*. *Self-pollination* takes place when the pollen of a flower finds entrance to the stigma of the same flower. *Cross-pollination* takes place when the pollen of one flower finds entrance to the stigma of another flower. The pollen coming into contact with the stigma feeds on the sugary

substance on its surface and sends down a long tube through the style entering the cavity of the ovary. Through this tube the male germ is brought into contact with the female germ in the ovule through its *microphyle*—the hole which leads to its interior. The resulting products of this union or *fertilization* as it is called are :—

(1) a mass of protoplasm which contains the characteristics of both the parents and develops into the primary part of the new plant or *embryo*, and (2) the *endosperm*, the store of reserve material in the seed. It is this reserve material in

the seed which keeps the seedling alive, feeding it until it fixes its roots in the soil and is able to take its own food therefrom. The seed is the final stage of one generation of plant and is the initial stage of the next generation, composed as it is of the fundamental vegetative organs, a root, a stem and the first leaves in miniature.

Cross-fertilization. Hybridization : When the pollen is taken from the flower of a particular variety of one species and placed on the stigma of another flower of a different variety belonging to the same species, plants raised from seeds so obtained, are the result of cross-fertilization ; they inherit the characteristics of both the parent plants and they are, generally, more vigorous than plants which are the result of self-pollination. A *hybrid* is produced by pollinating the flower of one species with the pollen from a flower of a different species. The processes by which new varieties and species are thus created are termed cross-fertilization and hybridization.

Seed and its parts : The seed, as seen above, is the result of the changes taking place in an ovule after fertilization. The seed may have only one or two coats. The body of the seed within the seed-coat consists of an *embryo*, which is the young plant contained in the seed, and a substance called the *albumin* or *endosperm*. The embryo is embedded in the albumin. There are seeds however which have no albumin or endosperm. On examination of embryos of seeds which have begun to sprout, it is observed that a seed consists of (*a*) one or two *cotyledons*, the first seed-leaf or leaves of the embryo, (*b*) the *radicle*, which is the lower or the root-end of the embryo and (*c*) the *plumule*, which is the first bud, the upper end of the embryo. Monocotyledonous embryo has only one cotyledon ; dicotyledonous embryo has two cotyledons.

Germination of seed : The awakening of the organs of life and the beginning of growth in the seed is called *germination*. Seeds germinate when placed under suitable conditions. Essentials for germination are air, a certain degree of moisture and warmth or suitable temperature. If sufficiently warm—the amount of the warmth required varies with the seeds of

different kinds of plants—moisture is absorbed by the seed, which causes it to swell up and burst the seed-coats. Oxygen is absorbed from the air. Certain chemical changes accompanied by liberation of carbon-dioxide take place in the embryo, which result in the solid substances which the seeds contain in the cotyledon and the endosperm being made available for the use of the growing plant. The radicle is always the first to come out, curving down towards the earth, whatever may be its position; it forms by its direct prolongation the *primary root* of the plant. The plumule shortly afterwards disengages itself, ascends and develops into the stem, bearing foliage and flowers. (Refer to Fig. 2 on page 5.) It is thus seen, that the food stored up in the seed, supplies not only the necessary energy to the embryo to wake up and start life as a tiny plant but it also sustains this little plant till it develops and is able, by itself, to get its food from the soil and to assimilate carbon from the carbonic acid gas in the air.

Plant physiology : Plant physiology is the science which deals with the functions of the parts of plants above described. In dealing with plants, we must realise that we are dealing with living objects. Plants, like animals, breathe, take food, excrete, move and react to external stimuli. For their continued existence, they require food, air and water, and if any of these is wanting, plants cease to live. Again, like animals, they try to propagate their species, as is evident from their efforts to flower and produce seed. It has already been observed what the functions of roots, stem and leaves are and how they divide the labour of sustaining the plant and reproducing the species. The slightest injury to any part reacts on the entire plant just as a whitlow or even a scratch on the little finger causes pain. The merciless amputation or the wounding of the branches or the stem or roots, etc., has likewise a bad effect upon the tree as a whole. Hence, it might be interesting and profitable to have some knowledge of plant physiology and to study the several important garden operations in relation to this subject.

Assimilation through roots : Plants prepare organic food from inorganic elements and ultimately all the food thus

formed becomes available to animals. The roots which permeate the soil absorb from it food materials consisting of mineral salts in a state of solution in water by a process called *Osmosis*, by virtue of which liquids of different densities have a tendency to mix; the thinner liquid consisting of water containing the nourishing salts enters the cell at a more rapid rate than the thicker plant-sap which moves downward to form more roots and secrete what is not wanted by the plant. It is to facilitate this intake of raw materials through roots, that plants are regularly manured and watered. Root-hairs absorb dissolved food from the soil and transmit it from cell to cell of the root until it reaches the vascular tissue, along which it passes to the various parts of the plant. The energy required for this is obtained by the oxidation of the tissues of the roots. The oxygen for this purpose is derived from the air present in the interstices of the particles of soil. If the soil is waterlogged, the interstices are all filled with water and the roots die for want of proper aëration.

Efficient digging and hoeing operations are intended to loosen the soil and promote aëration of the roots. Waterlogged soil is drained for the same purpose. As the number or density of root-hairs is in direct proportion to the abundance of, and suitability of the food absorbed by them, the care taken by the gardener to promote fibrous roots, by manuring and transplanting processes, to secure their fullest development, and to prevent them from injury, during transplanting, digging and hoeing operations, is fully justified. As roots can take in food only in a soluble form, the immediate stimulating effect of liquid manures is accounted for.

Carbon-assimilation through leaves : Leaves play the most important role in the physiology of plants. They are the laboratories of the plant. Light, photo-chemically acts on the green colouring matter, the chlorophyll of the leaves and tender the parts of the plant, causing it to manufacture the complex substances known as carbohydrates, such as sugar and starch. The process is rapid and is very complicated. These organic substances are made from the carbon-dioxide of the atmosphere, taken in by the leaves directly through their pores in conjunction with the nutritive salts derived through

the roots. This process of food formation has been named '*photosynthesis*' and it can only go on in sunlight, when carbon-dioxide and water are available, and only through the agency of the chlorophyll. By the work of the leaves, carbon-dioxide is taken out of the air, which is made richer in oxygen by that liberated from leaves after the fixation of the carbon. Consequently, air is purified and made fit for animals to breathe.

Results of overcrowding : By photosynthesis, a plant gains in actual substance much more than it does from the materials from the soil—only 2.5% of its weight being estimated as coming from the soil. In fact, plants can be grown without soil as in hydroponic gardening provided they are allotted sufficient air space and light and the roots are supplied with water containing small quantities of the inorganic salts which they need in great dilution.

When planted too close to each other, plants cut off sunlight from each other. Carbon assimilation becomes limited and therefore their growth becomes very much reduced. As only their top shoots can secure adequate supply of light, there is a competition among the plants for maximum sunlight and they all grow tall and thin without making corresponding side growths, exhaust themselves, topple ultimately one above the other, as observed in the case of seedlings damping off when sowing is thick.

Parasitic and saprophytic plants : Plants, which have no chlorophyll in them, cannot make their own food and necessarily have to get it from other living beings, dead or alive. Plants thriving on dead organic matter are called *saprophytes*. The common Mushroom is a saprophyte. Plants which derive their food from other living plants by robbing them of a certain amount of their ready-made food are called *parasites*. The Mildew fungus is an instance of a tiny parasitic plant and the Loranthes of a large parasitic plant usually seen on Mango trees.

Necessity for water : Water which is obtained by plants through their roots from the soil is very essential for their existence. It is necessary to keep the protoplasm alive. It forms nearly 90% of the total mass of the living plant. A

force—root pressure—causes the rise of the watery fluids in the plant and makes growth possible by keeping the tissues filled with water. During photosynthesis, water continuously passes up from the soil through the roots to the remotest ends of the plant—the broad surfaces of the leaves—carrying raw food materials, which are to be converted there into living substance and other complex chemical compounds. Very little of the water is utilised by the plant for its growth processes. Almost the entire quantity of water is given off as vapour or transpired from the pores of the leaves, after its work as carrier of food is over, making room for further supplies from the soil. A sort of current, called the transpiration current, is thus kept up. The quantity of water transpired by plants and removed from the soil is great. A mature apple tree has been estimated to lose by transpiration as much as 250 lbs. of water in a single day. Transpiration would be more during a hot than a cold day. When the loss by transpiration is so great that the soil is unable to supply the essential quantity of water for plant growth and sustenance, the leaves of the plant fold slightly to close up the openings in an effort to save loss of water. In other words, the plant wilts and will die if the soil is not replenished with water.

Respiration in plants : All the living parts of plants carry on respiration just like animals both day and night. Respiration is distinct from and the converse of photosynthesis. It is a triple process consisting of the taking in of oxygen to the living cells, the uniting of this oxygen with some of the foods or else with the living substance itself present in the cells, and the liberation of carbon-dioxide as a waste product. Oxygen supplies the necessary energy to cells to perform their work. Although plants have no lungs as animals have, they nevertheless have a very efficient system for taking in air and for distributing it. A connected network of air spaces ramifies the plant-body, so that every living cell of the plant gets its supply of air.

Composition of plants : Plants when split up by chemical processes, are found to be composed largely of carbon, which forms the bulk of the plant, hydrogen and oxygen in lesser

quantity, still less of nitrogen, sulphur, phosphorus, potassium, calcium, magnesium, iron, sodium, chlorine and silica and often traces of zinc, copper, manganese, iron boron. As explained already, plants acquire raw materials either by absorption through the roots or by photosynthesis. It has been seen how plants get carbon from the atmospheric air. They get hydrogen from water and from ammonium salts in the soil. Oxygen, they take up in a free state from the air and also in a state of combination in water and mineral salts. Plants cannot make use of the free atmospheric nitrogen. It must be presented to them in a combined state, as soluble nitrates from the soil. Members of the Bean family (Leguminous plants) obtain some of their nitrogen in a different way. There are found tubercles or nodules on their roots, in which certain bacteria live, which take free nitrogen from the air present in the soil and build up the nitrogen so taken into compounds (nitrates) which are passed on to the plant. How plants obtain nitrogen is elaborately dealt with in Chapter III. The other necessary elements are taken by plants from the soil in which they are present as ammonium, potassium, calcium and sodium sulphates, phosphates and chlorides. Iron helps formation of chlorophyll. The elements which are usually used up for growth and have consequently to be added to the soil are nitrogen, potassium and phosphorus. They are supplied in the form of organic manures and commercial fertilizers, which are rich in these elements.

Heliotropism : Plants respond to external stimuli such as heat and light. Stems and leaves have a tendency to grow towards light, as any window plant will demonstrate by its turning to the source of light. This reaction to light is known as *heliotropism*. It is on account of this characteristic movement that plants in the fernery and house or window plants have to be turned in their places every now and then to keep them growing symmetrically.

Optimum temperature and light : Temperature is a factor that largely influences the growth of plants. Both the physiological activities of carbon assimilation and respiration, and hence the growth of a plant, are accelerated by a rise in temperature up to a point beyond which growth is retarded

or suspended and the plant is even killed. Growth is retarded and the plant dies by too great a fall in temperature also ; excessive heat or excessive cold kills all activity in the plant and is responsible for losses during severe summer or frosty winter. The range of temperature within which growth processes can take place varies in different kinds of plants, being too narrow in some and wide in others. There is always a certain temperature known as the *optimum temperature*, which varies with every plant, at which it thrives best. There is similarly an *optimum intensity of light* for each plant. This explains why some plants require more shade than others.

Influence of climatic conditions : The climate of a place, which is determined by a combination of such characteristic conditions as temperature, intensity of light, rainfall and humidity, atmospheric pressure and movement, controls the physiological activities of plants. Light varies daily as also from season to season, in direction and intensity, in different parts of the world. There is, further, diurnal and seasonal variation in temperature. Humidity of air fluctuates in different places and at different seasons. Water contents of the soil occasioned by drought and heavy rainfall and the soluble materials in the soil also vary. Differences in these and other factors such as altitude and distance from the sea account for the differences in the growths and productivities of the same species or varieties of plants in different localities and during different seasons and also explain why certain plants thrive in some places better than in others. It should, however, be observed, in passing, that a plant is a self-adjusting organism, which tries to adapt itself to its environments. It seldom dies without a struggle. In order to achieve successful results, it is incumbent on the gardener to select the plant material suited to his place and also adjust the calendar of garden operations according to the conditions of climate peculiar to it.

Life history of plants : All the changes which a plant undergoes from its birth to death constitute the different stages of its life history. Plants of comparatively small size, usually with soft and succulent stems, which die down every year are called *herbs*. If they die completely root and all, in the first year or season of their origin, they are called *annuals*. The

life history of an annual consists in the germination of the seed, the production of the seedling, its growth to maturity, when it flowers and produces the reproductive elements, which unite to form seeds, which again contain fresh embryos, which preserve the race, though the plant itself dies. If the crown or root-stock of the herb survives the following year, the plant is a *biennial* but if it survives and produces year after year a fresh plant or plants, it is called a *herbaceous perennial*. *Shrubs* are mostly perennial plants with branching woody stems and not attaining to the dignity of trees. *Trees* are characterised mostly by a distinct primary stem or trunk. There is no cut and dry dividing line between these classes of plants; herbs may pass into shrubs and shrubs into trees by endless gradations.

Classification of plants : One method of botanical classification of plants is based on the natural resemblances and differences in the structure of the vegetative and reproductive organs. To the practical horticulturist, some knowledge of this classification is useful, as similar plants often call for similar treatment. The whole plant kingdom can be divided to fall under four great groups.—(1) The *Thallophytes* include the lowest form of plant life consisting of single celled or associations of single celled plants. The two chief families of this group are (a) the Algæ and (b) the Fungi. The former are commonly found as the green scum on the surface of small ponds and lakes. The latter are of a higher form than the algæ, are devoid of green colour and get their nourishment from decaying vegetable or animal matter or living plants and animals. (2) The *Bryophytes* are a large group consisting of two families of tiny plants (a) the Liverworts and (b) the Mosses. The former live in water or marshy land. The latter are a step higher than liverworts and are true plants which have a stem and rudiments of roots. (3) The *Pteridophytes* are a great group including the Lycopods, the Horsetails and the Ferns. The Ferns are an improvement on the Mosses in having real roots and leaves (fronds) and a vascular system. (4) The *Spermatophytes* include all seed bearing plants and are divided into great orders (a) the Gymnosperms in which all the seeds are

exposed or naked as in the *Cycas* and the Pine (*b*) the Angiosperms, the flowering plants in which the seeds are covered and enclosed in seed capsules. The Angiosperms are sub-divided into Monocotyledons and Dicotyledons. These are again sub-divided into *orders* or *families* consisting of a number of familiar plants which are closely related. Each of these families comprises however a number of *genera* possessing distinct common characteristics. For classification of plants into families and genera, chief attention is paid to their floral organs—the number and the position of the parts that make their flowers, cones, or spore bearing organs. The genus, in its turn, includes several plants, resembling each other in one or more respects. In the genus itself, however, the different *species* are often distinguished by such characteristics as the hairiness or shape of the leaves or the habit of the stems. The narrowest systematic conception is the species, which includes plants so closely related that they must have descended from a common ancestor. Sometimes, individuals composing a species vary in very minor details as the shading in colour of the flower, etc., when they are called *varieties* of the same species.

Naming of plants : Plants are named by a binomial system of nomenclature. Each plant receives two scientific names ; the first indicating the genus, the second the species. In other words, every plant has a generic name and a specific name in the form of an adjective, either in Latin or Latinised language. The first letter of the generic name is in capital and the specific name begins with a small letter unless it is derived from the name of a person. Thus for instance, *Allamanda grandiflora* and *Allamanda violacea* and *Allamanda Aubletii* (Aublet's) are three species of the genus *Allamanda*. The names of botanical varieties follow the name of the species to which they belong, as *Petrea volubilis*, *var. alba*.

CHAPTER III

SOIL AND SOIL MANAGEMENT

Soil : Soil is the upper layer of the earth's crust, upon which plants grow and depend for their nourishment. It must therefore receive the gardener's first and primary attention. To every plant-grower is essential a knowledge of the science of the soil, as his success largely depends upon the choice he makes of the soil which would be best suited for growing his plants, and upon the manner in which he improves and works it. For, different plants have different soil requirements ; as for instance, some thrive in sandy soil ; some in heavy soil ; and some in soil rich in lime or peat and so on. Again different kinds of soil need to be treated differently.

Origin of soil : Soil originates by the weathering, disintegration and decomposition of rocks due to the action of several natural agencies such as frost, heat, cold, wind, air, rivers and steams and rain, etc. How soils are formed is a study which belongs to the province of geology. It is enough to note here that all soils are composed of mineral products, particles of rocks and organic remains of plants and animals, accumulating in the earth from time immemorial.

Variations in soil : Soils of different places vary in texture, chemical composition and colour, as they are derived from different kinds of rocks, which have been broken up into particles of different sizes and have different quantities of humus (organic matter) combined with them. Thus, though all soils are ultimately made up of only mineral products and humus, their properties are determined only by their chemical composition and their physical texture. If the particles of rocks are fairly large, we have sand or gravel ; if they are fine, we have heavy or clayey soil ; if the soil is rich in iron, we have red earth. The methods adopted to improve soils of different places are based upon altering or manipulating their texture.

Types of soil : It is no easy task to devise an arrangement of soil at once comprehensive and distinct ; but, for

practical purposes, soils may be classed in accordance with their physical composition under certain leading types as sand, clay, loam, gravel, peat and alluvial soil. It is important to note the characteristics of each of these.

Clay and improvement of clayey soil : Clay is composed of almost dust-like particles of rock which are less than 0.002 mm. in thickness and form more than 50 per cent of the total weight. The fineness of its particles gives clay its close texture and makes it more tenacious than any other kind of earth. The particles are so small that they are soft and greasy to the touch and are light and float in water making it muddy. Clay is plastic and adhesive while wet, which makes it difficult to work in that condition. Hence, it is called 'heavy' soil. In the dry state too, it is extremely difficult to work as it is very hard. Percolation of moisture through clay is well nigh impossible and the nitrifying bacteria are least active in it for want of air. Roots of plants cannot spread through clayey soil easily. In times of drought, it contracts giving rise to fissures through which much of the soil moisture is lost and the roots are thereby injured and ill-fed. Clay has a great degree of water-holding capacity, almost to the point of decided disadvantage. Hence all clayey soils should be drained to remove excess of water stagnating in them. Clayey soil, though it is the worst kind of soil that the plant-grower may come across, may be gradually improved and brought into workable condition by efficient draining, deep trenching, and incorporating into it plenty of organic manure, preferably horse manure, leaf mould and lime. Lime has a wonderful effect upon clayey soils. It separates the particles of soil which stick together making it porous and it also promotes nitrification. Clay is at once improved by a suitable admixture of sand. But this method of improving clayey soil may be prohibitively costly.

Sand and improvement of sandy soil : In sand, the rock particles are much larger than in clay and they can be individually seen and felt. They would vary from 0.02 to 2 mm. in thickness and form 90 per cent of the total weight. Sand has consequently a loose texture and possesses properties the reverse of clay. It is easily saturated with moisture and

readily allows water to pass through. Water that passes through sand, carries away its nutrient elements along with it rendering it poor and 'hungry'. Sandy soils therefore require to be frequently supplied with a heavy manure like cow-dung which is lasting in action. Their chief demerit is that they give up readily their food and water contents. This is rectified by improving their texture, by making them more close by digging in heavy loam or clay, or by digging in plenty of organic manure, such as leaf-mould and dung, and by treating them with lime or chalk occasionally. Lime has a cementing action upon particles of sand.

Loam, horticulturist's ideal soil : Loam contains clay and sand in approximately equal proportions. It contains a large quantity of humus also — much more than what is contained in sand or clay. It is the ideal gardening soil. It combines the merits of sand and clay, as it has a texture which is neither too coarse nor too fine. It has a fair degree of water-retaining capacity, is sufficiently porous and is aerated properly. It is also rich in all the elements necessary for plant life. To improve loam, only cultivation and addition of manure when the food contents in it are exhausted are necessary. *Sandy loam* and *clayey loam* are intermediate types of soil containing a preponderance of sand or clay in loam. The former is more porous and less retentive of moisture than loam and the latter is less loose and more retentive of moisture respectively.

Gravelly soil : Gravelly soil contains larger particles of rock than sand. It is improved by addition of clay and by digging in plenty of cow manure and plentiful irrigation. Lime also should be added if the soil lacks it.

Alluvial soil : Alluvial soils are formed by accumulation of sand, earth and loose stones brought down by rivers and streams. They are rich in humus too. Crops after crops may be raised in such soils for some time with only a little cultivation and addition of manure.

Peaty soil : One does not ordinarily come across peaty soil. Peat consists mainly of decayed vegetable matter in a state of greater or less decomposition, accumulated in the course of centuries on the margins of lakes and in marshy

land. Peat is used in composts for growing Orchids and such plants of the fernery as Dieffenbachia, Anthurium etc.

Value of humus in soil : Humus or organic matter in the soil is useful in more ways than one. The addition to the soil of the right quantity of humus in the shape of animal refuse or leaf mould improves its texture enabling it to absorb and retain moisture. Humus lightens heavy soils by making them porous and consolidates loose sandy soils. It raises the temperature of cold soils and maintains it in an equable condition. Soil bacteria which convert organic matter into nutritive salts are fed and activated by humus. If however, it is not in a thoroughly decomposed state, it has a tendency to make the soil sour by an excess of humus acid, which is detrimental to the growth of useful bacteria and hence to the growth of plants.

Improvement of soil : All that is necessary in tackling the soil in many gardens is a slight manipulation of its texture by cultivation and addition of required ingredients as lime and manure. The gardener has indeed a difficult task ahead when he is confronted with light sandy soil or very heavy clay. In gardens of small size, the difficulty is overcome by making pits or excavating trenches to the required depth and filling them up with suitable mixtures.

Functions of soil : Soil fulfills three essential purposes. First, it fixes plants in position by affording anchorage to their roots. Many a giant tree is prevented from toppling over during high winds on account of the firm hold the roots have in the soil. Secondly, soil supplies the moisture necessary to the roots of plants. Thirdly, it supplies to the plants through the roots, with the exception of carbon, all the elements which are necessary for their life and continued growth.

Advantages of cultivation : To enable the soil to function properly, the land should be well cultivated. Cultivation consists in loosening the soil and pulverising the clumps of earth. Cultivation is effected by ploughing, digging, trenching and ridging the ground. The object of cultivation is to help the roots to penetrate the soil in search of moisture and nourishment. They spread with greater ease in loose than

in compact soil. By cultivation, the soil is aerated suitably to the needs of the growing plant. The soil is better able to absorb moisture or rain water and to retain it, if worked well. Not only is any excess of soil moisture removed by working the soil deep, but it is also made warmer and more conducive to increased activity of beneficial soil microbes.

The depth to which soil needs cultivation depends upon its nature and that of the sub-soil (the soil below the surface layer, 6 to 12 inches below the surface is called sub-soil) and on the nature of the plant intended to be grown. Deep rooting plants require deeper cultivation than shallow rooted kinds. In clayey soil, deep cultivation is necessary. Such soil should be trenched deep.

There are three well recognised methods of working the soil. They are, ploughing, digging and trenching. Ploughing is the usual method of preparing land in agricultural operations, only the surface soil to a depth of about six inches being stirred in the operation.

Simple digging : Digging is done with the fork, or the spade, or the 'kudali', the favourite instrument of the malis. The fork is useful for digging heavy soil. With the spade, it is easier than with the fork to transfer the earth from one position to another. These instruments properly handled are more efficient than the Indian instrument, the kudali.

Simple digging consists in driving the instrument to the full length of its blade, about eight inches, into the soil, thus loosening it, and then turning it over. Digging is commenced by opening a small pit, say a foot wide and a spit (the length of the blade of the instrument) deep and transferring the earth so moved to the finishing end of the ground. Another trench is made in front of this opening and the soil is turned over to fill the first opening, at the same time removing weeds and grass roots and breaking large clods of earth. This process is carried on till at the finishing end, the last hole made is filled with the soil moved from the first opening. It would be wrong to begin digging without first opening a trench, as it would result in the soil becoming higher at one end than at the other. Manuring during digging is best done by spreading a layer of it on the land, so that a portion of it goes to

the bottom of the trench with each turning over.

Double digging : Double digging, or bastard trenching as the same operation is called by some, consists in working the soil two spits deep, that is, to a depth of about sixteen inches. The operation is commenced by opening out a trench about a foot wide and a spit deep and carrying the earth so disturbed to the finishing end of the plot. This trench is again worked a spit deep and the soil left in position. The top spit of the next trench is turned over to fill the first trench and the bottom layer of the second trench is worked a spit deep and the soil left *in situ* as before. The operation is thus carried forward till the entire plot is dug.

Method of digging : It is always best to proceed on a system in digging a plot of ground. For convenience, the ground is marked into strips ACEF, say

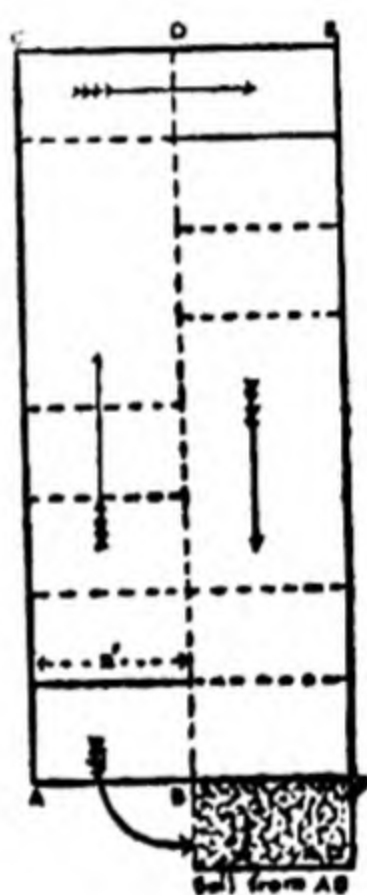


Fig. 11.

Marking out
a plot for digging.

4 feet wide, as shown in the figure. By dividing each strip into sections by a line DB drawn along the middle, much labour and shifting of soil is saved. Proceeding from AB, a trench is made a spade deep and the soil is removed to the end of the adjacent section BF. The bottom layer of this trench is worked and left in its position. Some garden refuse or manure may be put over the soil thus worked, to improve the lower layer of soil. Another trench is then made before it and its top spit of soil is turned over to fill the first trench; the bottom layer of the second trench is then worked and left in position; and so on, the operation is carried forward, in the direction of the arrow mark in the figure. The earth removed from the first trench is used to fill the last trench made. Double digging fulfils all the ordinary requirements in flower gardening.

Trenching : Trenching is deeper cultivation than double digging and is much more expensive. During trenching, the ground is marked out into strips 2-3 feet wide as in digging. The soil in the strip is removed to a depth of 2-3 feet and

carried to the finishing end of the plot. Into the first trench so made, a layer of garden refuse or coarse manure is placed to enrich the sub-soil. The soil from the next strip is turned over to this trench, layer by layer, until it is filled, the lower layer of soil now being on top of the first trench and a fresh trench is formed alongside. Whenever plenty of manure and refuse are available, it would be advisable to introduce it between the layers of soil, as they are turned over, using the good manure for placing on the top just beneath the surface of the soil. In this kind of trenching, the several layers of soil get mixed up. Unless the soil is uniformly good to a depth of at least 3 feet, there is always the danger of bringing to the surface inferior and comparatively unproductive sub-soil. "Dig deep to find the gold", is without doubt a golden maxim but it is limited in its application to soils which are uniformly good to a good depth.

Plant for trenching : The following plan carried on in much the same way as in double digging would involve less

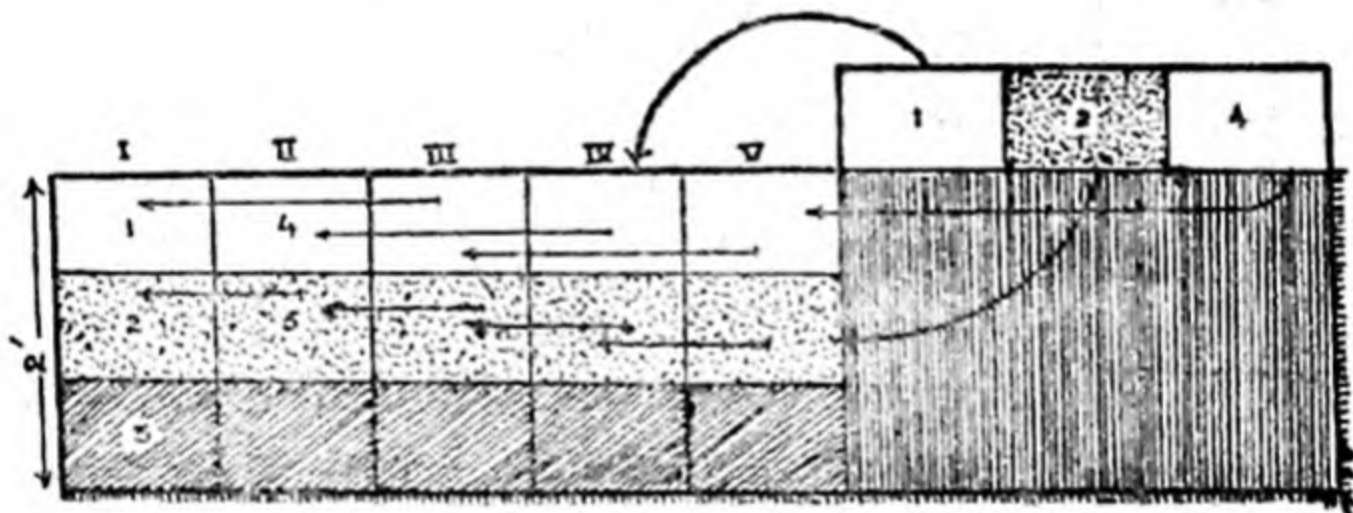


Fig. 12.

The illustrate method of trenching.

risk of top soil getting mixed up with the sub-soil in trenching operations. As shown in the figure, the entire length of the plot to be trenched is marked out into strips I, II, III, IV and V, etc., about a foot wide and 2-3 feet long as may be necessary. The top spit of soil (No. 1) from strip I is moved to the other end of the plot of land to be trenched and placed in a long row equal to the width of the land to be trenched, leaving similar space above for placing the second spit (No. 2) from strip No. I. Then, the second spit (No. 2) is removed and

placed accordingly. The bottom layer of soil in strip I (No. 3) is dug up again a spit deep and is left in its place. Thus, in trench or strip No. I, the soil is worked three spits deep. Again the top spit of soil from strip No. II (No. 4) is removed and placed below the 2nd spit from strip I. The second spit from strip from strip II (No. 5) is turned over to trench I to occupy the place of its second spit (No. 2) and the bottom of the second trench so made is worked a spit deep. Then, the top spit of soil from the strip III is turned on to fill the trench, in the first trench, and the second spit of soil in strip III goes and fills the space of the second spit (No. 5) of strip II. This process is continued till the three heaps of soil occupy their respective positions in the last three strips. If the soil calls for trenching deeper than 2 feet, it is worked in the same manner treating it as if it were made of more than three spits.

Conservation of soil moisture : The soil should contain sufficient quantity of moisture to be made available for plants. Moisture is lost from the soil by natural evaporation taking place from its surface and by transpiration from leaves of plants and weeds growing in it. The gardener's aim should be to make the soil absorb as much rain water as possible and help it to conserve the moisture. This is effected by good cultivation and weeding.

Much of the rain water that falls on hard ground flows away and only a small quantity soaks through it. If the ground is loose and well cultivated, it would absorb a large quantity of water. A portion of this absorbed water is held fast by the soil particles round them as a film of vapour due to surface tension and the rest freely passes down ultimately reaching the water table, where the water stands underground.

Apart from the downward movement of water mentioned above, there is an upward movement of water in the soil from the water table to the soil surface due to capillary force. One can easily imagine millions of fine capillary tubes originating from the level of underground water, rising through the interspaces of soil particles to the surface of the soil and conveying water to it, just in the same way that oil rises through the wick of a lamp or water through the bore of a capillary tube. As rapidly as water reaches the surface of the

soil, it is lost by natural evaporation, thus giving rise to a continuous current of water rising through the soil. The loss by capillary force is greater in the case of compact than in loose soils. Cultivation of soil, it is thus clear, reduces the loss of water by natural evaporation from the surface of the soil.

Mulching and hoeing operations: There are two familiar garden operations, known as mulching and hoeing, which



Fig. 13.

A. Scarifier.

B. Hand fork.

serve to conserve soil moisture by minimising its loss by evaporation from the surface of the soil and loss through weeds. Mulching consists in spreading a layer of partially decomposed manure, leaves, straw or any other material as cocoanut fibre over the surface of the ground. This is done to greatest advantage in times of drought. The material so spread not only minimises loss of water by natural evaporation but also protects the surface roots of plants from the scorching heat of the sun. Further, when rain falls,

the food elements of the mulch are washed into the soil, increasing its fertility. Hoeing consists in stirring or loosening the surface layer of the soil to a depth of one to three inches with a hoe or scarifier. The loosened earth acts as a "dust mulch". In addition to providing the soil with a mulch, hoeing promotes its aeration, destroys the hiding places of ground vermin and exposes them to be preyed upon by birds, and discourages growth of weeds.

DRAINAGE

Dangers of water logging in the soil: Air that is intermixed with soil, from its surface to the level of ground water, is continually being discharged into the atmosphere owing to its displacement by rainfall. In porous soil, the rain water rapidly finds its way down to the sub-soil water level as the obstruction to its passage is very little; thereby, it may raise the level of the sub-soil water. If the rainfall is excessive or if the soil is so very impervious that it resists the

passage of water, the soil becomes surcharged with moisture. In other words, the interstices between the particles of soil, originally occupied by air, become completely filled with water. In this condition, the soil is said to be waterlogged. In waterlogged soil, plants die as their roots cannot respire for want of air; noxious pans of iron and aluminium silicates are formed; beneficial soil microbes die, also due to want of air and due to the soil turning sour. It is therefore necessary to drain off the excess of moisture in the soil to make it agreeable for vegetative life to flourish. Efficient drainage is one of the most important points in connection with the cultivation of garden crops. It consists in drawing out of the soil only so much of 'free' moisture which is not required by plants and which occupies the spaces between the particles of soil, impeding aëration. The quantity of moisture which is held by the soil particles as a film encircling them due to surface tension is enough to satisfy the needs of the plant and that cannot be drained away. Drainage keeps the land in the best condition for the development of plants; it alters the texture of heavy soil by conducting away water and filling the space originally occupied by water with air; it enriches the soil in its feeding capacity by facilitating the decomposition of organic manures. It increases the temperature of cold soils and it furthers the activity of soil microbes.

Test for need for draining soil: Soil drainage is a difficult problem in India in places where rainfall is excessive and almost continuous during certain periods of the year. Unfortunately, little attention is paid to draining soil as it involves some expenditure. A low-lying piece of land would need to be drained to get the maximum benefit out of it. An apparently high or sloping land may need drainage too. It should be ascertained if it is only the surface water that has to be conducted away; in which case, surface drains have to be constructed. If water accumulates in the sub-soil, sub-soil drainage has to be effected. If the land is porous, that is, if it is light on the surface and has a porous sub-soil, water generally passes through naturally without need for drains. But if the soil is heavy with a sub-soil of clay or marl, which will not allow the passage of water through it,

sub-soil drainage has to be effected. If the land holds the water in puddles for a day or two following the rains, want of drainage is indicated. To make sure if draining is necessary, a few trial holes about three feet deep are made and left open for ten or fifteen days; if water accumulates in the holes within two feet of the surface, sub-soil drainage is necessary.

Surface drainage : Surface water can be conducted away through channels, 6 to 12 inches deep, made in suitable places and connected with ditches, tanks or public gutters. If the surface of the ground is on a dead level, with the result that the water falling on it cannot clear away, the ground should be worked and sloped in one direction. The slope should however be gradual to prevent erosion during the rains.

Sub-soil drainage with drain pipes : Sub-soil drainage is effected usually with drains constructed with agricultural drain pipes which are made of hard baked clay. They are in various sizes. Usually they are made without sockets, in 12-inch lengths of a diameter of 3 or 4 inches. Closely

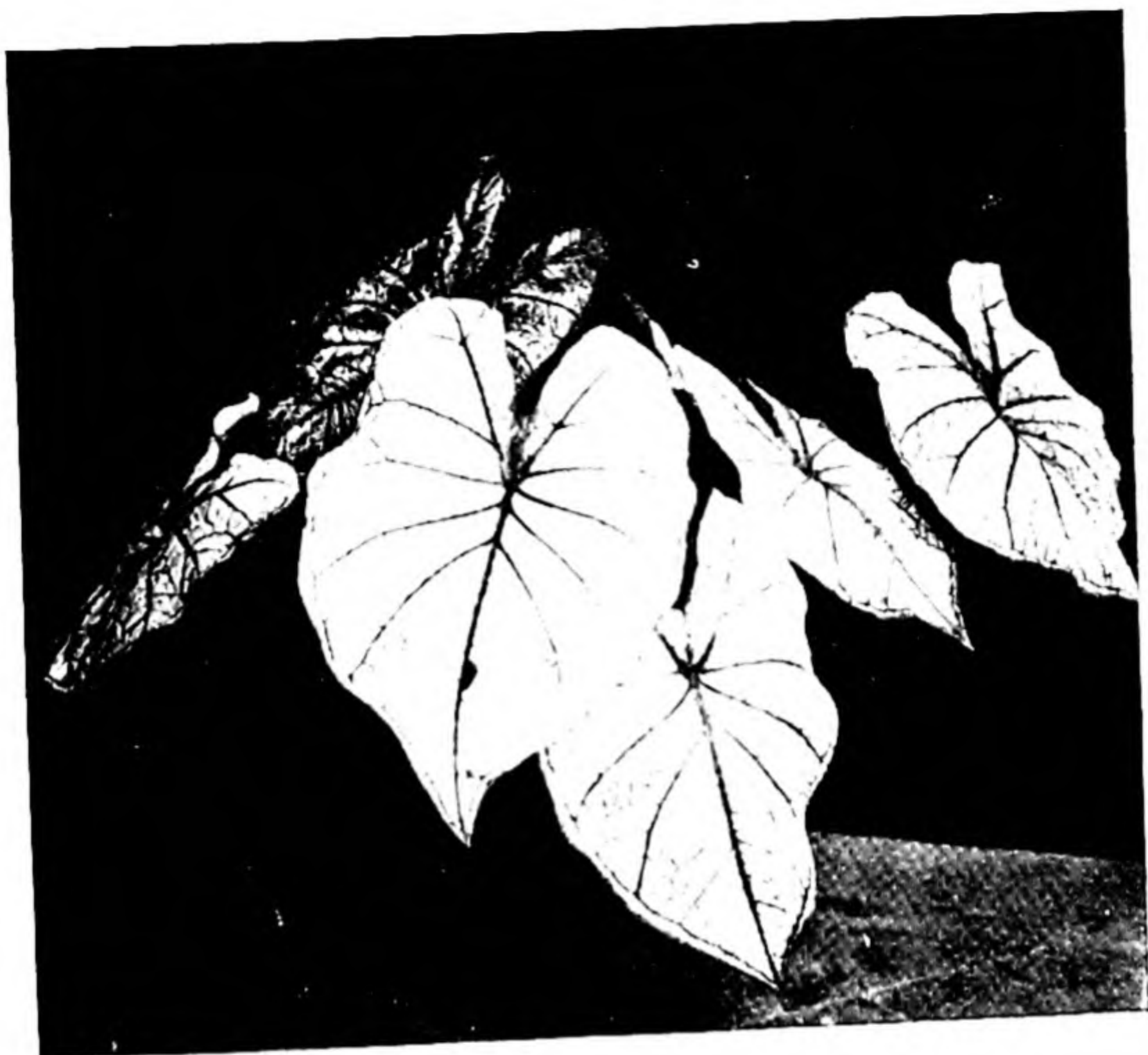


Fig. 14.

Contour of land and method of laying drains.

a. b. main drains, *s.* subsidiary drains. shown in the figure, in the lowest part of the land, and the subsidiary lines or feeders at right angles or obliquely to the main drains according to the formation of the land. The main drains should be large enough to conduct water from all the feeders along its course and may be about 4 inches in diameter. Run the main drain from the highest point to a reservoir or a water channel in the lowest part of the land to be drained : with an equal gradient throughout. The distance between the feeders should generally be in inverse proportion to the rainfall. In fixing the distance between the

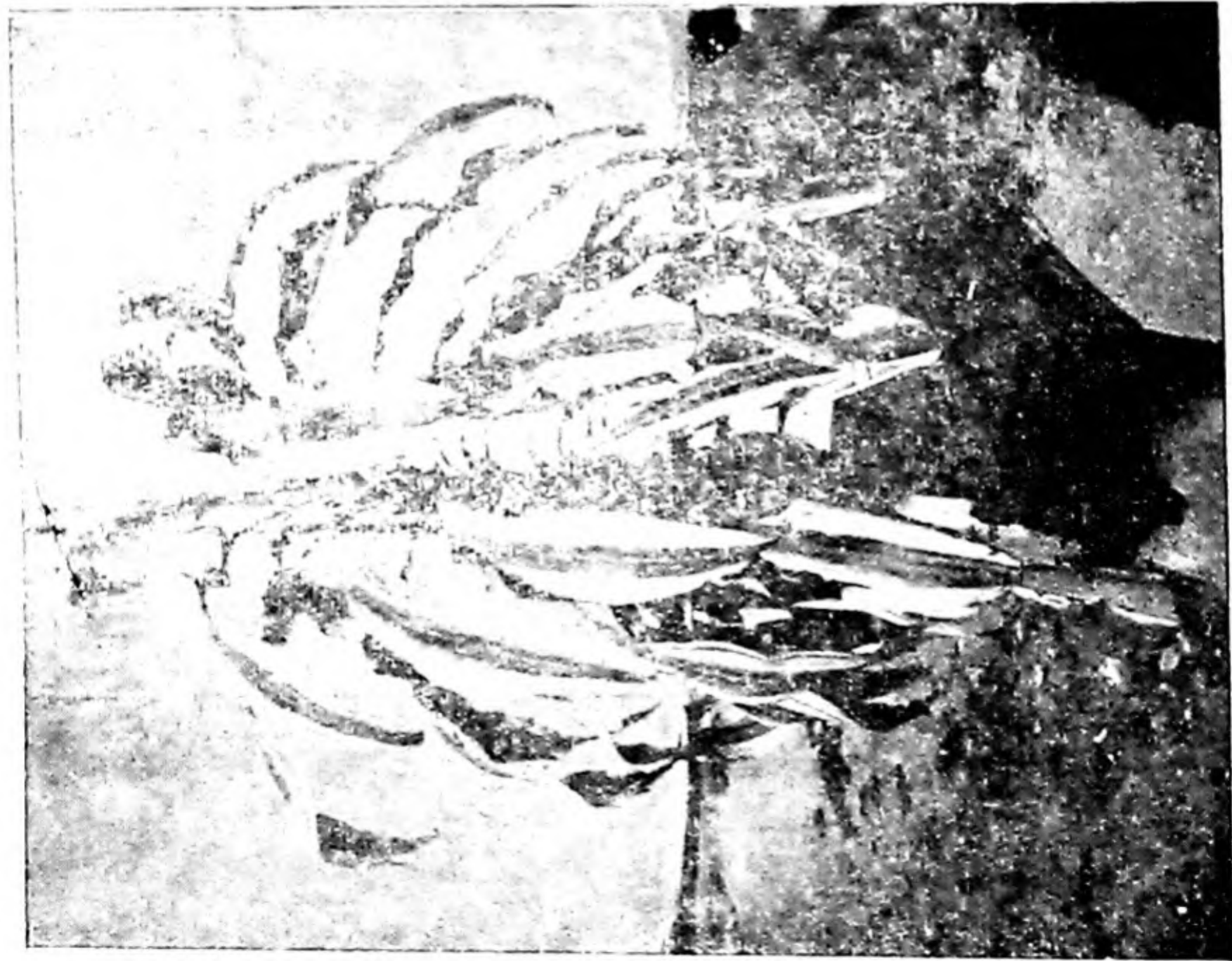
inserted one inside the other and placed end to end, they form straight earthen piping, through which water can be conducted away unobstructed. Study the contour of the land to determine the direction of the drains to be fixed. Run the main drains along the valley lines *ab*



CALADIUM



MARANTA ZEBRINA



DRACAENA VICTORIA



DRACAENA SANDERIANA

drains, take into consideration the texture of the soil and the relative rapidity with which the water has to be drained off.

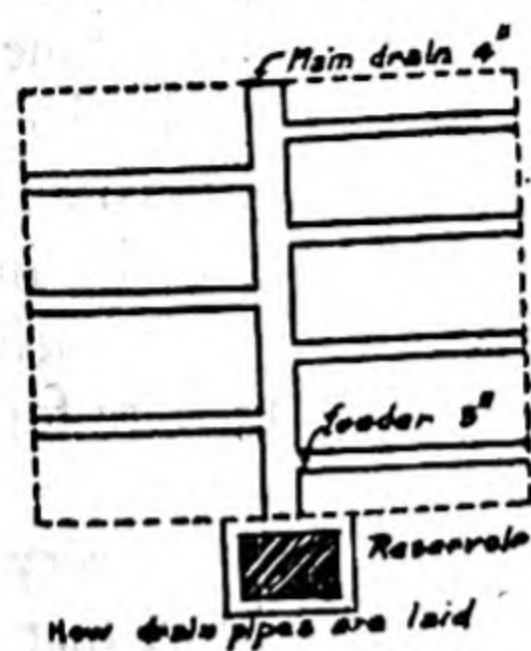
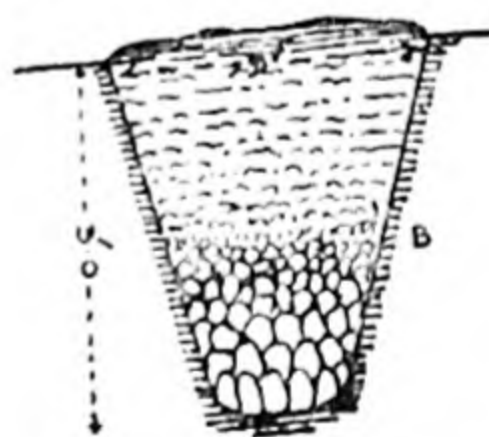
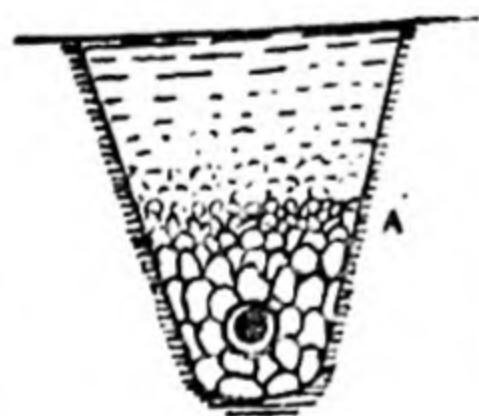


Fig. 15.

Have the drains 20 to 24 feet apart and 3 to 4 feet below the surface in clayey soil. In loamy soil, set the drains 30 to 35 feet apart. In sandy soil, the drains may be 50 feet apart. Whenever possible, lay drains in true straight lines, with an inspection chamber or eye at every change in direction. For laying drains, open V shaped trenches 2 feet wide at top and 1 foot wide at the bottom and 3-4 feet deep, according to heaviness of the soil. Grade the bottom with a slope of 1 in 100 to 1 in 300 feet. Connect the feeders with the main pipe by sockets and cement the joints. The drains so laid are too deep to disturb ordinary operations. Lay the pipes along the bottom and fill the trenches to a depth of not less than 12 inches with broken stones or similar rough material. Use large stuff for packing in the bottom layers. Use material which does not readily disintegrate. Fill the rest of the trenches with smaller stones and rubble in the lower layers finishing off with garden refuse and loose earth.

Sub-soil drainage with rubble drains: If there are trees near by, their roots get into the openings of the pipes and



Tile drain with covered stones

Rough stone drain

Fig. 16. A. & B.

clog them. In such places, unless the trees are cut down, it is not practicable to have pipe drains. In their place, rubble or stone drains can be made. For making these, dig trenches

as recommended above, grading the bottom also as described above. Place semi-circular roofing tiles or stones in the lower twelve inches and cover with layers of smaller stones or rubble, finally filling up with sods or garden sweepings and loose earth. Such drains, though absolutely necessary at the time of the formation of the garden, may become dry in course of time, being filled up with the roots of trees, which take up the work of the drains, by utilising the moisture for their growth.

Life in the soil. Work of soil microbes : Soil is very thickly populated with life of a microscopic order. More than 2000 millions are estimated to be contained in a teaspoonful of it. This rich population is of a very varied character. Some of these micro-organisms are harmful and many are useful. The net result of their presence and activities has an important bearing on the fertility of the soil. The main groups of soil life are (1) Algæ, (2) Fungi and (3) Bacteria. Their importance is shown below.

Algæ are simple microscopic chlorophyll bearing plants without distinction of roots, stems and leaves, living in the soil and trapping the energy of sunlight to grow and leaving their bodies when dead to accumulate as humus in the soil.

Fungi are minute plants without chlorophyll, either living as parasites on other plants, or thriving on dead matter saprophytically, and thus helping the further breaking down of organic material by bacteria. Some fungi better the health of plants by living in symbiosis on their roots and feeding them with assimilated food. All fungi, being plants, add to the humus content of the soil, when dead.

Bacteria are the most useful of soil organisms. They are unicellular and less than $1/25,000$ of an inch in diameter. They multiply rapidly in prodigious numbers. Their numbers vary in the soil at different seasons. In summer, they are more active than in winter. They exist in hundreds of species. The useful ones may generally be classified under the following groups :— (a) those that cause organic matter to generate heat, decay, and release the nitrogen contained in them chiefly as ammonia—a simple compound of nitrogen and hydrogen ; (b) those that convert the ammonia so liberated into nitrous

acid and nitrites by uniting it with the basic elements in the soil ; (*c*) those that convert the nitrites to nitrates, in which form, the plants get their nitrogen from the soil through their roots in a state of solution in water ; and (*d*) those particular kinds which live in the nodules or tubercles in the roots of leguminous plants (Bean family) and take nitrogen direct from the air and 'fix' it in those nodules to be built up into nitrogen compounds useful to themselves and to plants by other sets of organisms. This fixation of the free atmospheric nitrogen by soil microbes takes place in the soil silently by the energy supplied by the oxidation of carbon compounds such as sugar, starch, straw etc., in the soil—a feat which is accomplished by scientists only by the use of prodigious electric power, very high temperature, very great pressure and catalytic agents. As long as these substances are in the soil, oxidation goes on and bacteria do their work. In addition to the above-mentioned beneficial microbes, there are some harmful ones in the soil, which cause denitrification in the soil under certain conditions. When the soil is waterlogged, they get the oxygen they require for their existence by decomposing the nitrates in the soil and setting nitrogen free, which is lost.

Soil fertility : The capacity of soil to produce and sustain plant growth is known as soil fertility. The mineral particles of soil derived from the weathering of rocks contain, no doubt, an inexhaustible store of plant foods ; but they would be useless and incapable of feeding plants without the presence and interaction of its other constituents, *viz.*, soil air, soil moisture, soil microbes, and humus. Fertility of soil is low, if its mineral particles predominate the other constituents, as seen from the fact that the top layer of earth, six to twenty-four inches in thickness, is the most fertile as it contains the largest quantity of humus and soil population and enjoys the greatest penetration of sun and air and that soil deeper and deeper down is more and more sterile. Hence, the gardener takes care not to bring this up as most of his garden plants do not root below 24 inches and introduces top soil into trenches and pits for deep rooting shrubs and trees.

Summing up what has been mentioned above, the gardener adopts the following procedure to increase the productiveness

of the soil :—(1) He manipulates its texture suitably, by adding clay to sand, and lime to clay, humus to sand and clay. (2) He cultivates it by ploughing, by spade work, by digging and trenching. (3) He drains the soil, if it is waterlogged. (4) He adds more organic material in the shape of green manure or dung or leaf-mould to replenish its humus content, as need arises. (5) He also adds artificial manures or inorganic fertilisers to supplement the deficiencies in the soil and (6) He maintains the soil in a neutral or very slightly alkaline condition by liming it periodically or when necessity arises. The soil is acid when it turns litmus solution blue, is alkaline if it turns it red, any other colour indicating nearness to neutrality.

CHAPTER IV

MANURES AND THEIR USE

What are manures : It has been observed in Chapters II and III that plants get the elements they are composed of from atmospheric air by photosynthesis and from the soil by absorption through their roots in forms soluble in water. Manures are substances which are added to the soil for encouraging and sustaining plant growth. They increase soil fertility, either directly, by supplying what is requisite, or indirectly, by their action on other substances that might be present already in the soil but not in a suitable state for being absorbed. Manures may have the plant constituents in them combined in a natural or artificial manner as in dung and commercial fertilizers respectively. The strength of manures and their suitability to certain crops and soils should receive due attention from the gardener. While application of manures to plants at an improper time or in an improper manner produces direct harm or possibly death to the plants, the same application in a suitable manner and in proper season is attended with beneficial results. In the application of manures, the object should be to make them afford as much soluble matter as possible to the roots of plants and that in a slow and gradual manner so that it might be entirely consumed in forming their soft and organised parts. It is evident that organic matter, whether of vegetable or animal origin, should undergo a process of decomposition before it can be utilised for the nourishment of plants. The decomposition may take place partly prior to its application to the soil or in some cases it may be entirely effected afterwards.

Organic and inorganic manures : Manures are usually divided into two classes *viz.*, organic and inorganic manures. Organic or natural manures, as they are also called, include excreta of animals, animal matter, such as blood, bones, flesh, wool, horn, etc., and decomposed vegetation. They are more or less complete manures, in the sense that they contain and supply in greater or less degree, all the essential nutritive

elements, Inorganic or artificial or chemical manures or 'fertilizers', as they are variously called are of mineral origin. They are either specially manufactured or are found in nature as such. They are phosphates, potash salts, salts containing nitrogen, and salts containing other elements.

"Essential elements" : For plant growth, the soil should contain all the necessary elements in available form in sufficient quantities. If any of them is wanting, growth is suspended. Nitrogen, potassium and phosphorus are the three elements which are greatly in demand and are therefore called the "essential elements" which need to be supplied to the soil periodically as they are used up in much greater quantities than others. Nitrogen is essential for making the protoplasm for new cells and for their growth. It promotes vegetative growth. In other words, it builds up the stem, leaf and green parts of plants. Phosphorus promotes root growth, makes up the texture of the fruit, assists in the ripening of the tissues of plants, in the production of flowers and in the formation of seed. Potassium enhances the flavour of fruits and vegetables and it is associated with the manufacture of starch and sugar in a mysterious way. It also enables plants to resist attacks from fungi. Calcium acts as food, besides improving the texture of the soil. Iron has a certain bearing on the chlorophyll. Magnesium is essential, it is not known why. Addition of minute amounts of manganese, copper, zinc, aluminium or boron to the soil deficient in them has been known to bring about normal and healthy growth in some cases. The soil contains generally enough quantities of these elements to last for all time and hence they are not usually added to it as manures. With regard to the amount of manure to be supplied to the soil, the quantity of the respective elements already present in it should be taken into consideration. And, this is determined by soil analysis.

Classification of manures : From a practical point of view, manures are best classified under six heads, as suggested by Weathers in Commercial Gardening :—

(1) Complete manures which, as mentioned above, supply not only nitrogen, phosphorus and potash, but also other essential foods like sulphur, iron, sodium, magnesium,

chlorine, etc. All organic manures are complete manures.

(2) Nitrogenous manures, chiefly supplying nitrogen, as for instance, sodium nitrate and ammonium sulphate.

(3) Phosphatic manures, chiefly supplying phosphorus, as for instance, superphosphate of lime.

(4) Potassic manures, chiefly supplying potash, as for instance, potassium sulphate and wood ashes.

(5) Calcareous manures, such as chalk and lime which added to the soil release by their action other foods which are tied up in the soil in an unavailable form.

(6) Miscellaneous manures, such as iron sulphate applied for specific needs of particular plants.

Important organic manures : The more important organic manures used in our gardens are mentioned below :—

Stable or horse manure is stored and made ready for use in the following manner :—Dung and stable refuse are thrown into a pit or heaped up in a shady corner. The material is moistened with water once or twice to hasten decomposition. Otherwise, too much heat is developed, which results in the escape of much of the valuable ammonia gas which is formed and is the chief source of nitrogen. The dung heap is covered with a layer of earth to absorb the ammonia gas which would otherwise be lost. To prevent nutritive substances from being washed away, the manure heap is protected from rain. The manure is ready for use in about six months, when it can be powdered with ease by gentle pressure without sticking to the hand. In this condition, horse manure enters into the compost used for growing all kinds of ornamental plants. Unless well decomposed, horse manure has a burning tendency on tender roots. It is lighter in texture, quicker in action, as it ferments more and is better suited for horticultural purposes than cow-dung. It is also comparatively free from Cockchafer grubs. Horse manure is a safe stimulant, and produces almost immediate effects. A top dressing of this manure in a well decomposed state, mixed with half its quantity of loam, applied as often as may be necessary, stimulates plants to vigorous and strong growth and hastens flowering. Such top dressing of horse manure or the use of liquid manure prepared from horse or cow manure is safer to use than artificial manures,

which involve risks to the health or the life of plants, if applied injudiciously. Horse manure is better suited to heavy than light soils. It accelerates warmth in the soil and renders it friable and light.

Cow or cattle manure is stored and prepared for use in much the same way as horse manure. But, it takes a longer time to decompose, taking nearly a year before it becomes usable. It is heavier than horse manure and acts more slowly and hence its value is more lasting. In this country, cattle manure is used chiefly in kitchen gardening and in fruit culture. If freed from grubs and well decomposed, cow manure could however be used in place of horse manure for growing ornamental plants. As cow manure is more retentive of moisture, watering is to be done carefully especially in the case of pot plants. It is more suited to light than heavy soils.

Urine of cattle or horse is rich in nitrogen. It should be used after considerable dilution with water as it has a strong burning effect upon tender roots.

Sheep or goat dung is preferred to horse or cattle manure for fruit trees. Sheep dung is believed to expose trees to fungus pests to a less degree than either cattle or horse manure. Sheep dung is best used in connection with light soils and it serves as a stimulating liquid manure productive of excellent results.

The above-mentioned dung manures contain about 0.6, 0.35 and 0.6 per cent of nitrogen, phosphoric acid, and potash respectively, the percentages varying with the substances the animals feed upon. Four to eight pounds of them are best spread upon the ground for each square yard and dug in.

Night soil is a powerful manure, rich in nitrogen. The chief objection to its use is based on sanitary and sentimental grounds, on account of its offensive odour when it is not sufficiently decomposed. But, if allowed to lie in a pit for a year or so, with alternate layers of soil and covered over ultimately with earth, night soil is deodorised. It could then be used with very good results. It is extensively used by market gardeners for growing vegetables. As it is a strong manure, regular watering should be done when it is used. A pound for a square yard would be a good dose for all kinds of soil.

Guano is a well-known manure, rich in nitrogen and phosphorus, containing 10-15% of the former and 9-12% of the latter. It occurs, deposited in large quantities, principally off the islands of the coast of Peru and South America. It is the excrement of sea birds accumulating over several centuries. Pure guano is a powerful stimulant and it is safely used mixed with about six times its weight of soil. The supply of pure peruvian guano is practically exhausted and is replaced by other brands in the market containing varying percentages of food contents. Two ounces, either dry or dissolved in water may be used for one square yard. Guano may be applied as liquid manure for all pot plants.

Fowl or Poultry manure contains about 1.8% of nitrogen, 1% of phosphorus, and 0.5% of potassium. It is richer than cattle or horse manure, is similar in action but milder than guano.

Fish manure or fish guano contains 8 to 10% of nitrogen and 6 to 9% of phosphorus and is advantageously used for fruit trees.

Bones are rich in calcium, phosphorus and nitrogen and contain up to 30% of phosphoric acid. Bone is slow in action and it is used for growing flowers, fruits and vegetables. In a powdery form, known as bone-meal, bone is obviously more rapid in action. Bone-meal is very popular with gardeners, being usefully mixed with soil mixtures for pot plants. It may be spread on the surface of the soil at the rate of 4 ounces per square yard and forked in.

Blood (dried) is rich in nitrogen containing as much as 12 to 15% of it. It is quick in action and induces strong growth. One to two ounces per square yard may be used on all soils.

Oil-cakes are residues left after the oil is extracted from the seeds of groundnut, castor, rape, gingelly, pongamia, etc. and they contain 3 to 5% of nitrogen and 1.5 to 2% of phosphorus. Oil-cakes are stimulating manures being rich in nitrogen. Pongamia and groundnut cakes are very largely in demand for manuring purposes. If applied in too large doses, pongamia cake causes the 'burning' of buds in flowering plants. Oil-cakes are best applied for pot plants in the

form of liquid manure. In a powdered form too, oil-cake may be mixed with advantage in small quantities with other ingredients in composts.

Soot is very little used in this country, but it gives good results, as it is composed principally of the charcoal which has fertilising properties due to the ammonia contained in it. It is quick in action and contains 1 to 6% of nitrogen. It may be spread on the surface of the soil at the rate of 4 to 6 ounces per square yard. It can be hardly misapplied. Soot-water which is made by suspending a bag of soot in a tub of water is a valuable liquid manure, which brightens the colour of foliage. Soot also acts as a preventive against larvæ of insects, snails and slugs.

Leaf-mould. Withered and dry leaves (Bamboo, Tamarind and Casuarina leaves are best avoided) and garden sweepings, which are free from disease, are thrown into a pit in a shady corner in the garden and covered over with earth and watered copiously once or twice in summer to assist decomposition. The leaves become reduced to a state of mould in the course of nine months to a year. When well decomposed, leaf mould could be powdered and sifted through wire meshes. In irrigated pits, the mould is made in a shorter time. It is one of the most indispensable manures to the horticulturist. Although it can be made with ease in all gardens, it is purchased at a prohibitive price.

Leaf-mould is rich in humus and is hence usefully applied to both sandy and clayey soils. It is very useful in the cultivation of delicate seedlings and delicate plants. It forms part of composts for palms, ferns, bulbous plants, delicate annuals and foliage plants, and for striking soft-wooded cuttings. Addition of leaf-mould to flower beds at least once a year is attended with very good results. Leaf-mould when mixed with imperfectly decomposed horse manure is used in the making of hot-beds, as it prevents violent fermentation and helps to maintain a moderate degree of heat for a long time.

Wood ash is rich in potash and can be used as a top dressing at the rate of 8 ounces per square yard, which would work out at an ounce of potash for a square yard. Root vegetables require liberal manuring with potash.

Charcoal absorbs ammonia and has some manurial value. Broken up fine, it is used in composts for ferns and orchids to maintain the soil in a sweet condition.

Inorganic manures : Inorganic manures usually supply one essential plant food and hence are called "relative manures" as they are used for specific purposes in relation to the needs of particular kinds of plants at any particular time. They supply either potassium, nitrogen or phosphorus and the chemicals supplying these elements to the soils are known as potassic or nitrogenous or phosphatic manures. In this connection, it is necessary to sound a note of warning against the so-called proprietary fertilizers which are claimed to serve as complete manures for growing plants. Inorganic manures (potassic, nitrogenous or phosphatic manures) are best used separately at different stages of the plant's growth according to its needs. Their use is also largely dependent upon the actual needs of the particular soil. As such, an indiscriminate use of special mixtures may do more harm than result in any good. Even when it is desired to mix two manures, it is best the grower does so himself, using the right quantities needed by his soil, as determined by soil analysis.

Inorganic manures should be used guardedly, as they contain the essential elements in a highly concentrated form. It is safer to err on the side of applying too little of them than too much. Too great a concentration of chemical manure in the soil results in the death of the plants as they would lose water from their root tissues by ex-osmosis. They are used only to supplement and not to supplant organic manures. It would be cheaper to apply them in small doses along with the quantity of organic manure that might be available. Artificial manures used by themselves without an adequate quantity of humus in the soil are very harmful. Excessive use of them, especially nitrogenous fertilisers, pre-disposes plants to fungus diseases. Their prolonged use destroys the tilth of the soil and inhibits the beneficial activity of the soil microbes. They act as stimulants, without lasting benefit to the soil, and require to be added every year to the soil. They are often caustic or acidic in reaction and if used too freely are apt to burn the tender roots of plants if watering is

not freely done. They thus render the soil unfit for growing plants in course of time. Hence, it should be emphasised that artificial manures are productive of good results only when used in conjunction with organic manures. It is mentioned by some scientists that vegetables and fruits raised from soil deficient in humus, and hence in plant hormones, by repeated use of fertilizers are poor in their vitamin value.

IMPORTANT INORGANIC FERTILIZERS

The following are the more important chemical fertilizers with which the gardener may be familiar :—

Nitrogenous Fertilizers : *Nitrate of soda* (salt petre) contains about 15% of nitrogen. It may be applied to the soil at the rate of $\frac{1}{2}$ —1 ounce per square yard or 1—2 cwts. per acre. It should not be applied when the soil is dry. It should not be brought into contact with foliage. The soil should be copiously watered after its application. It is very easily soluble in water. Being a nitrate, it is very quickly absorbed by plants and is therefore a powerful stimulant which is employed for quick results. Being very soluble, it is likely to be washed out of the soil very soon and hence is best applied in small quantities at a time instead of one heavy application. Sodium nitrate is unsuited to tracts where saline deposits exist. By prolonged use, it destroys the tilth of the soil by making it more sticky on the surface. As it is alkaline in reaction, its use may be alternated with ammonium sulphate which is acidic in reaction. One ton of cattle manure would be equivalent to about 50 lbs. of sodium nitrate in nitrogen value.

Ammonium sulphate is a greyish white powder containing 20.6% of nitrogen. Its nitrogen, being in the form of ammonia, has to be converted first to the nitrate form in the soil to be readily absorbed. It is therefore slower in action than sodium nitrate and is used in similar doses and with same precautions. It is better suited to damp and heavy soils. As it is acidic, it is not safe to use in connection with soil deficient in lime. Soils which have been continuously manured with ammonium sulphate would need to be 'limed' once in three years.

Nitrolim (*calcium cyanamide*) is a less known fertilizer than the above ; it is a black powder, which contains 20·6% of nitrogen and 22% of lime. As it is rather unstable and loses ammonia by volatalisation, it is sold in drums and should be forked into and covered over with soil immediately after its application. It is very useful in connection with soils poor in lime. One ounce per square yard applied two or three weeks before planting seedlings or sowing seeds would give best results.

Other nitrogenous fertilizers, still less common than the above are *calcium nitrate*, a deliquescent very easily soluble salt containing 13% of nitrogen, equal in its effects to sodium nitrate and more useful in connection with soil wanting in lime ; *ammonium nitrate*, a very quick acting manure containing as much as 35% of nitrogen.

Phosphatic fertilizers : *Super phosphate of lime* is a yellowish white powder prepared from bone or mineral phosphate by treatment with sulphuric acid. Available in two grades, it contains 13 to 40% of soluble phosphoric acid and is acidic in reaction, requiring to be used with the same caution as ammonium sulphate or soda nitrate. One to three hundred weights may be applied to an acre for most crops. For flower plants, 2 ounces per square yard would be sufficient, applied when they are in a healthy growing condition and are about to bloom.

Basic slag is a by-product in the manufacture of steel, is a black finely divided powder containing 8 to 18% of phosphoric acid, which becomes available to plants slowly. Being rich in calcium, it may be applied with advantage to heavy soil deficient in lime at the rate of 2 ounces per square yard.

Potassic fertilizers : They are applied at the early stages of plant growth, while planting or sowing. They render plants less susceptible to disease. *Potassium sulphate* contains about 50% of potash and is applied at the rate of 1 cwt. per acre or $\frac{1}{4}$ oz. per sq. yd. *Potassium chloride*, called *muriate of potash*, contains about the same percentage of potash and is used like the sulphate but is not so safe on account of its chlorine content for certain crops as Onion, Potato and fruit trees.

Mixed fertilizers : A mixture of super phosphate of lime and ammonium sulphate in the proportion of one of the

former to two of the latter is generally used by several gardeners, as it serves both to build up the body of plants and to produce a good crop of flowers.

Two or more of the above mentioned fertilizers, containing the essential elements in unknown quantities are often sold commercially as "complete fertilizers" for certain crops. It is best the agri-horticulturist prepares his own mixtures based upon his own soil analysis and suited to particular soil reaction. When soil analysis is not made, a safe mixture is one which contains nitrogen, phosphorus and potassium in the proportion of 5-1-2, respectively as recommended by Willcox. The ingredients mixed should not interact with each other rendering them valueless.

Calcareous manures : *Lime*, when added to soil, plays an important role in improving its texture, in increasing the solvent action of soil-water, in acting chemically on manures added to soil and in preventing sourness in it. Lime has a magical effect on soils incapable of yielding good results ; it renders clayey soil less sticky by disintegrating it ; it cements sandy particles of poor light soils assisting them to retain moisture ; it effects the decomposition of vegetable and organic matter producing ammonia, nitric and carbonic acids and renders them into soluble and consequently easily assimilable compounds. Heavily manured soils with too much humus in them and which have turned sour on account of excess of moisture are greatly improved and corrected by digging in lime. Lime also acts as a mild preventive against fungus and insect pests in the soil.

For the first one or two years of cultivation, Indian soils need no liming, as they generally contain some amount of lime. The following is an easy method of finding if soil needs liming. A handful of the soil to be tested is dried and placed in a glass saucer and a little dilute hydrochloric acid is poured on to it. If the soil effervesces unmistakably, enough of lime is indicated. If no effect is noticed as the acid soaks into the soil, it requires addition of lime. But, if there is only some fizzing with practically no effervescence, presence of only a small quantity but not enough lime is indicated in the soil.

The best mode of liming the soil is to slake lime and

spread it on the surface at the rate of two ounces per square yard. If the soil contains some lime already, addition of lime rubbish or old mortar will do. Liming need not be done more than once in four or five years. It has been found by experience that one or two spoonfuls of lime stirred into the soil in pots which has turned sour by over watering, very much improves the condition of plants. Old mortar is sometimes added to the composts for Crotons and Dracaenas and such other coloured foliage plants with the belief that the colours of the foliage are better developed. If quick lime is not available, chalk can be used instead, with slower action.

Other inorganic manures : *Sulphate of iron* is quick in action ; $\frac{1}{2}$ ounce per square yard is quite sufficient ; used when chlorophyll deficiency is indicated by pale green colour of the leaves.

Sulphate of magnesium produces strong growth in some cases, applied $\frac{1}{2}$ -1 ounce per square yard.

Sodium chloride (Common salt) benefits some crops as Cocoanuts, Beet, Cabbage, by liberating the potash in the soil making it available for the plants. In large doses, however, it is poisonous.

Mixing of manures : Certain manures should not be mixed with certain others, as they interact chemically, neutralis-

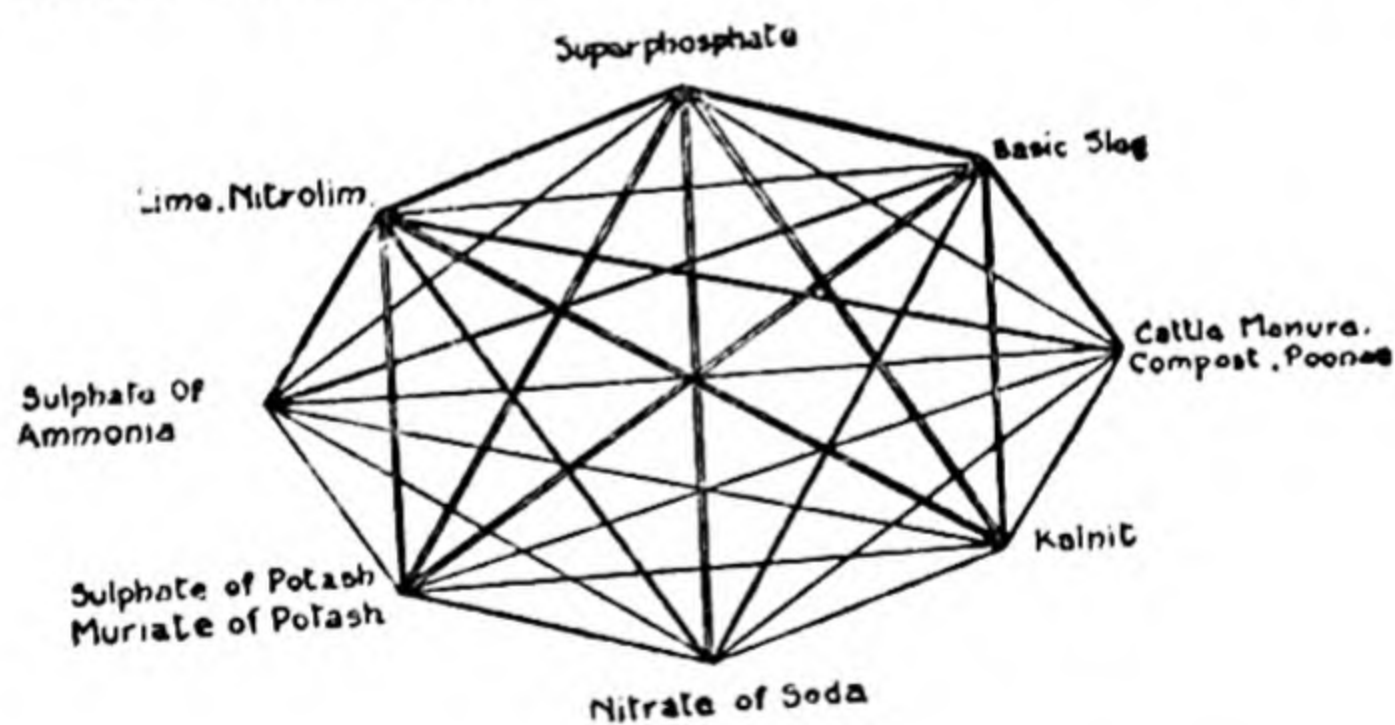


Fig. 17.

Diagram to show which manures can and which should not be mixed.

ing the principles of each other or liberating substances injurious to plant life. The following note on the mixing of

manures taken from Dr. Anstead's pamphlet on Coffee Cultivation will be found useful :—"It must be carefully borne in mind that certain fertilizers must not be mixed together at all under any circumstances, such for instance as lime, or basic slag with sulphate of ammonia or manures containing nitrogen. Others again may only be mixed just before they are applied as they have a tendency to cake and become hard ; such for instance as super-phosphate with sulphate of potash. The diagram above shows at a glance what fertilizers may and what not be mixed. Materials joined by a heavy black line should not be mixed together under any circumstances, those joined by a double line should only be mixed if the manure is to be applied immediately, while those joined by a single line may be safely mixed together at all time".

Liquid manures and their use : Manures are quicker in action and more effective, if they are applied dissolved in water, instead of waiting for them to dissolve in the moisture contained in the soil. Liquid manure is nothing more than manure dissolved in water. It may consist of artificial salts, such as ammonium sulphate, potassium sulphate or super-phosphate or organic manures as cow-dung, horse-dung, sheep-dung dissolved in water. For flower plants such as Roses, Dahlias, Chrysanthemums, various kinds of oil-cakes and especially the Pongamia oil-cake is left in water to rot for a few days and the resulting liquid is diluted many times with water and used with excellent stimulating results. Urine of cattle or horse, which is too strong, can be used on plentiful dilution with water.

In horticultural work, the amateur finds liquid manure quite indispensable for his plants. But for it, he would be seriously handicapped in exhibition work. It is stimulating, beneficial, and productive of immediate results. It may be used both for plants in the ground and in pots. The right kind of manure, nitrogenous, phosphatic or potassic, can be applied when required, by dissolving it in water.

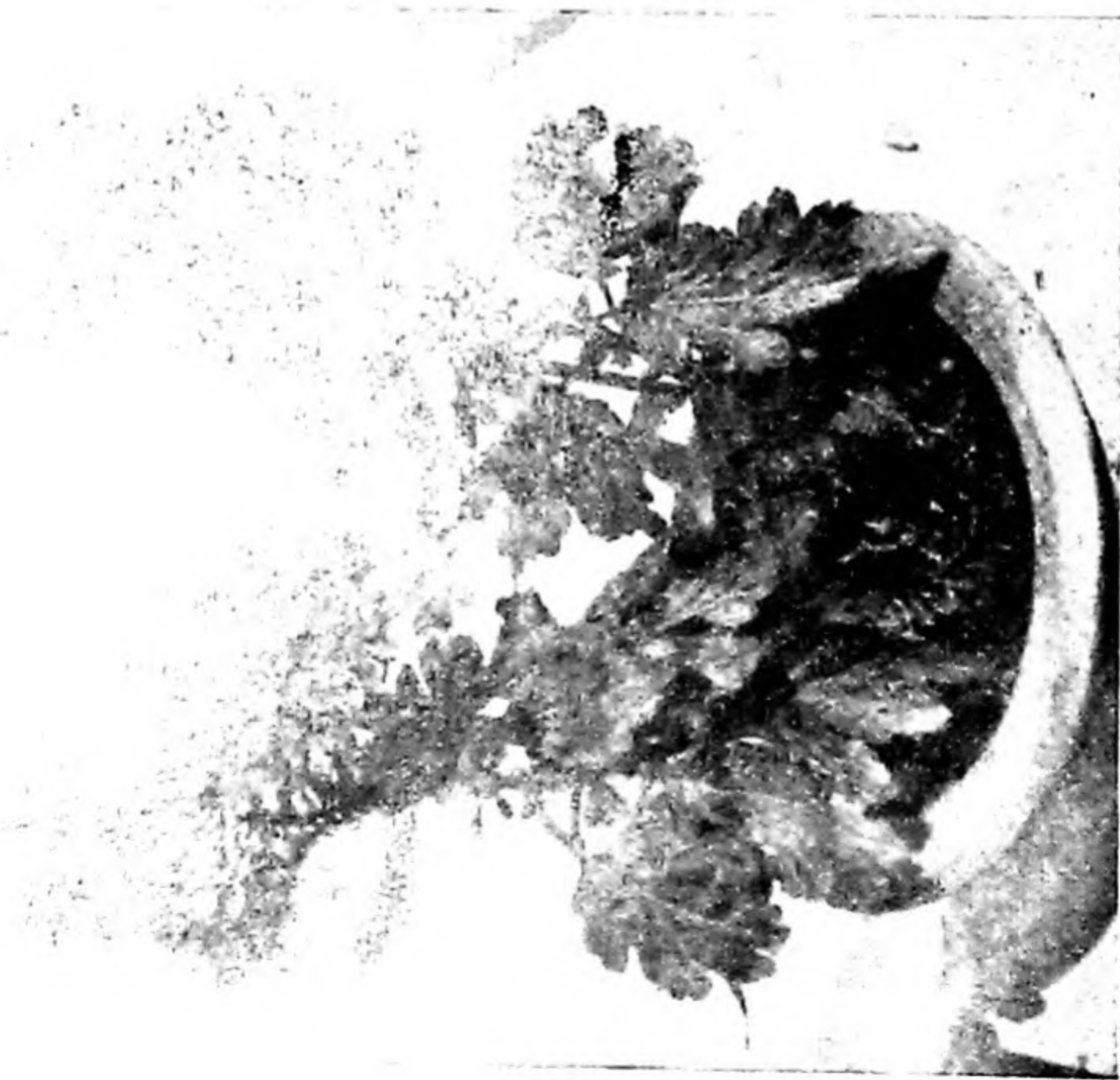
In the application of liquid manures, 'weak and often' should be the rule. If the solution is strong, water passes from the cell-sap in the root-hairs through their membraneous walls and comes out to the soil, as a result of which the plant



A NEW STRAIN OF GIANT COCKSCOMB INTRODUCED BY THE AUTHOR IN 1921



KOREAN CHRYSANTHEMUM



FLORIST'S CHRYSANTHEMUM

collapses. To prevent this "ex-osmosis", care should be taken that liquid manures are applied only in a state of great dilution.

Liquid manures are easily made. Cow-dung is the favourite stuff used, on account of its harmlessness. Fresh dung is

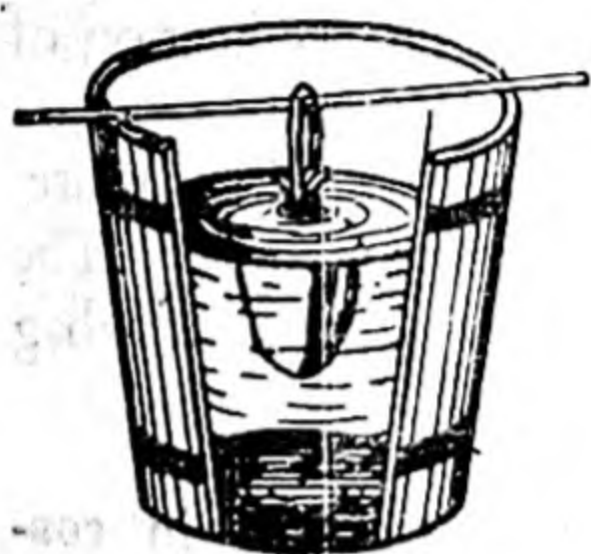


Fig. 18.

How liquid manure is made.

tied up in a muslin bag and suspended in water in a tub. The water gradually dissolves the soluble parts of the dung. After three or four days, the dark liquid in the tub is diluted till it assumes the colour of light tea decoction. To get the full value from it, it is necessary to prepare liquid manure from fresh dung. All suspended matter is strained away, as it would otherwise choke the air spaces in the soil necessitating stirring of the soil

after application of the manure. Liquid manure is similarly made from horse or sheep dung. The latter is particularly rich and very stimulating in action. One peck of any kind of dung will make about 40 gallons of liquid manure. As fowl or poultry manure is very strong, about half a peck of it may be used for making a like quantity of manure.

One ounce of ammonium sulphate, or potassium sulphate, or ammonium phosphate or soda nitrate may be dissolved in two gallons of water. Two ounces of 'super' may be dissolved in like quantity of water. Artificial manures are often acidic or caustic and burn the tender roots of plants. Hence, they should be used only after wetting the soil through with water, and they should not be brought in contact with foliage.

The best time for application of liquid manures is when the plants are well established and are growing actively. Flower plants are supplied with them from the time flower buds are forming till they show colour. The manure is to be applied in weak doses once a week or a fortnight. Fruit trees are supplied with liquid manures when the fruits are setting. Nitrogenous manures are applied for colourful foliage and vigorous growth. Phosphatic manure is used for flower

formation at the time of blooming. Potassic manure is applied when the fruits are set and are growing, for better quality, flavour and taste.

Liquid manures of all kinds, are best applied when the soil is wet. The drier the soil, the weaker should be the solution. The liquid should not be spilt over shoots and foliage. The soil should be stirred after each application of manure.

In Western countries, soot is applied as a liquid manure, one peck making about 30 gallons of liquid manure. The ammonia and the soluble contents go into solution if a bag of soot is suspended in water for a day or two.

Summary of important points to be remembered in connection with manures and manuring:—

Choose the manure to suit the particular soil and the plant. Apply the right kind of manure in proper time.

Animal manures require care and management in storing them to conserve their valuable properties. Never place them outdoors exposed to sun and rain. Cover them with a layer of earth to fix the escaping ammonia gas.

It is always safe to manure a little and often than much and seldom.

Never use undecomposed manure, as it has a burning effect on roots and destroys them.

Easily soluble manures, as for instance the concentrated chemical fertilizers, should not be applied just before the rainy season, as they are liable to be washed away. Organic manures may be dug into the soil with advantage before the rains.

Do not mix manures which interact with each other. Do not mix lime with manures rich in nitrogen and which part with it easily, as for instance lime with guano, horse or cowdung; do not mix soda nitrate with superphosphate.

Water plentifully when artificial manures are used. Do not bring them in contact with foliage.

Organic manures cannot be dispensed with when commercial fertilizers are used. The latter are only to supplement and not to supplant organic manures.

Do not freely manure newly planted plants and trees.

Add manure to soil only after they have established themselves. Don't supply liquid manure to sickly plants.

Do not make the composts of pot plants very rich. Top dress the soil with mixture of manure and soil, when the plants establish and are growing.

The best time to apply liquid manures to flowering plants is when the buds are forming; to fruit trees after the fruits are set at intervals, until they begin to colour; to vegetables during their active growing period; and to pot plants when the pots are full of roots.

The wrong way to manure trees and shrubs would be to apply them very near the stem. As feeding roots are away from the stem, apply the manure, from half to four feet away



Fig. 19.

Diagram showing how a tree or shrub should be manured.

Dig in manure in space aa' leaving space sa all round the stem. Next year roots grow out beyond a' as shown between $a'b$. Then, dig in manure in space $a'b$.

from the stem to the extent of the entire spread of the branches, as roots generally travel to that extent under the ground. The bigger the tree or the shrub, the greater is the distance away from the stem the manure is to be usefully applied.

Economic manuring: "green manuring": With the gradual replacement of animal by motor transport, there has been an increasing difficulty in obtaining animal manure for field crops and garden flowers. The farmer and the gardener are both faced with the problem of having to find an alternative and comparatively cheaper source of organic matter for

the soil. Application of artificial manures without organic matter in the soil is attended with serious consequences. The value of farm yard manure consists in its large humus content and its superiority over the commercial fertilizer is due to its double barrelled action on the soil in increasing its fertility by providing food for and stimulating the activity of soil microbes and in maintaining and improving its texture. As vegetable matter, such as straw, decayed leaves, etc., is also capable of adding to the humus content of the soil, it stands to reason that digging into the ground a quantity of vegetable matter, especially leaves of Leguminous plants and trees as *Pongamia glabra* ('Punga'; 'Honge'), would also enrich the soil when they decompose in it.

Green manuring is an ancient practice which is well worth reviving. It consists in growing a crop of a quick nature and digging it in before its growth becomes unmanageable. Usually, the plants are dug in just before they flower or when they are with flowers. Members of the Bean family are obviously preferred to other plants for green manuring. *Crotolaria juncea* (Sunn hemp) and *Tephrosia candida* (Boga medeloa) are two favoured green manuring plants. Horsegram, Cow-pea, Dhal (*Cajanus indicus*) and Groundnut, may also be thought of, if crops are also desired from plants used for green manures. In intensive farming, green manure crops are best grown as a part of a special rotation in which part of the year is given up to green manure. As the green manure plants also take up much nutrition from the soil, though they give back to the soil valuable food after they are dug in and decompose in the soil, it is prudent and even necessary to apply requisite quantities of commercial fertilizers to the soil, before the seeds of the regular crops themselves are sown. Ordinarily, an ounce of fertilizer consisting of 4 parts of superphosphate, 1 part of ammonium sulphate and 1 part of potassium sulphate may be applied for each square yard of space and raked in to a depth of 2-3 inches.

Economic preparation of poudrette or activated compost from garden sweepings :—

Fallen leaves or fresh cattle dung or horse dung with bedding straw dumped into shallow pits take 12 to 18 months

to decompose and become fit for use as manure. What nature takes so long to achieve can be speeded up by 'composting'. The principle of composting consists in 'charging' or 'inoculating' organic refuse with fungi and bacteria which are necessary to bring out its decomposition and in producing conditions favourable for their rapid multiplication so that the material may be completely and quickly rotted.

Everything that will decay—any garden refuse, dead leaves, horse or cow-dung, wood ashes, unutilised parts of garden crops—furnishes the material for preparing compost. Unhealthy leaves, as also woody branches, should be burnt and

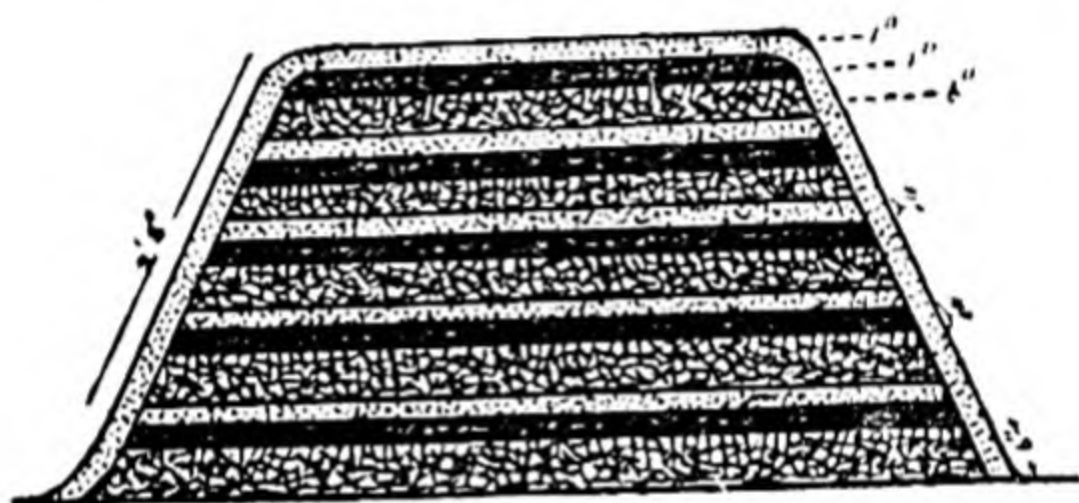


Figure for composting.

the ashes used. All coarse material should be crushed or cut up into small bits. When enough material is collected, in a position sheltered from wind and sun and preferably from rain also, the refuse is spread over an area of 8 feet $\times$ 8 feet, or less according to convenience, to the thickness of 6 inches. This is covered loosely with fresh cow or horse-dung to the depth of an inch. A layer of top soil, one inch thick, is spread over the manure. Thus, the heap is built up to a height of $2\frac{1}{2}$ to 3 feet and jacketed when complete with surface soil about an inch thick. While spreading the different layers of material one over the other in the order mentioned above, care is taken not to trample and make it compact. If the material is not heaped loosely, bacteria do not develop for want of enough aeration. Each layer of material is just moistened as it is spread with a water can and rose. The cow-dung or horse-dung is used to furnish some quantity of nitrate and to charge the material with bacteria along with that contained

in the top soil. If the soil is acid, a sprinkling of ashes or lime over each soil layer will keep the material sweet for development of bacteria. In place of dung, urine earth—earth collected from cattle sheds drenched with urine—may be used alternating with layers of organic refuse and the same earth may be used to cover up the heap instead of ordinary surface soil. Dried leaves collected and spread out with layers of soil as mentioned above and moistened with dilute cow-dung water will also rot quickly. The temperature of the heap begins to rise and after 24 to 36 hours, it would go up to 130° to 140° F on account of rapid decomposition. Fungus growth is established in 10 days as would be seen from the white mould when the material is taken out and examined. The rise of temperature would be enough to kill all weed seeds. After three weeks, the heap is turned over, moistened with water or very dilute cattle urine or dung water and heaped up loosely. Incorporation of small quantities of old manure—about 30 days' old—will accelerate decomposition by providing some more food and microbes for the microbes to finish their work. The heap, thus turned over and moistened every third week, will be fit for use in $2\frac{1}{2}$ to 4 months.

If there is any difficulty in securing cow or horse dung or cattle urine or urine earth for making compost, patented 'accelerators' commercially produced and put in the market, such as the Adco, may be used to convert leaves and plant refuse easily into valuable manure. Compost may also be made by making up a heap with nine-inch layers of refuse sprinkled with ammonium sulphate and superphosphate alternately, moistening the layers as the heap is built up. A thin sprinkling of lime in between helps to keep the heap from turning sour. For every 100 lbs. of material, 1 lb. of superphosphate and $1\frac{1}{2}$ lbs. of ammonium sulphate is used. The heap is covered with a layer of soil and kept just moist. It is turned over after two months and slightly moistened. The material will be fit for use in about a fortnight more.

The compost so prepared is rich in humus and plant foods and is known to give excellent results with all kinds of plants.

CHAPTER V

GARDEN IMPLEMENTS AND ACCESSORIES

The 'mali' is satisfied if he is supplied with a small and a large 'kothali', a 'mamti', a pick-axe or a mattock, a 'varavari' or 'pilcheduki' and a 'kurpi' or 'kudugolu'. He manages to carry on his work with these implements. He is not accustomed to work with imported implements as the spade, the fork and the shovel. But he can be easily taught to handle these instruments and do his work quicker. Many are the kinds of labour-saving tools and implements which are offered for sale. They may be purchased as necessity arises. It would pay in the long run to secure only strong durable materials and keep them clean.

The instruments used for digging and trenching are the 'kothali', pick-axe, digging fork, spade and the 'mamti'. The 'kothali' is the familiar instrument in India with which all digging is done. The 'mamti' is not only used to dig loose soil but is also used to turn it over while digging and trenching. The smaller sized 'kothali', worked with a single hand is used to remove weeds and to stir the surface soil between plants as the Dutch hoe. Of *hæs*, which are imported tools, there are several types. They are used for cleaning and weeding purposes and for stirring the surface soil. The *Pick-axe* is used for breaking hard soil. One of its ends is pointed

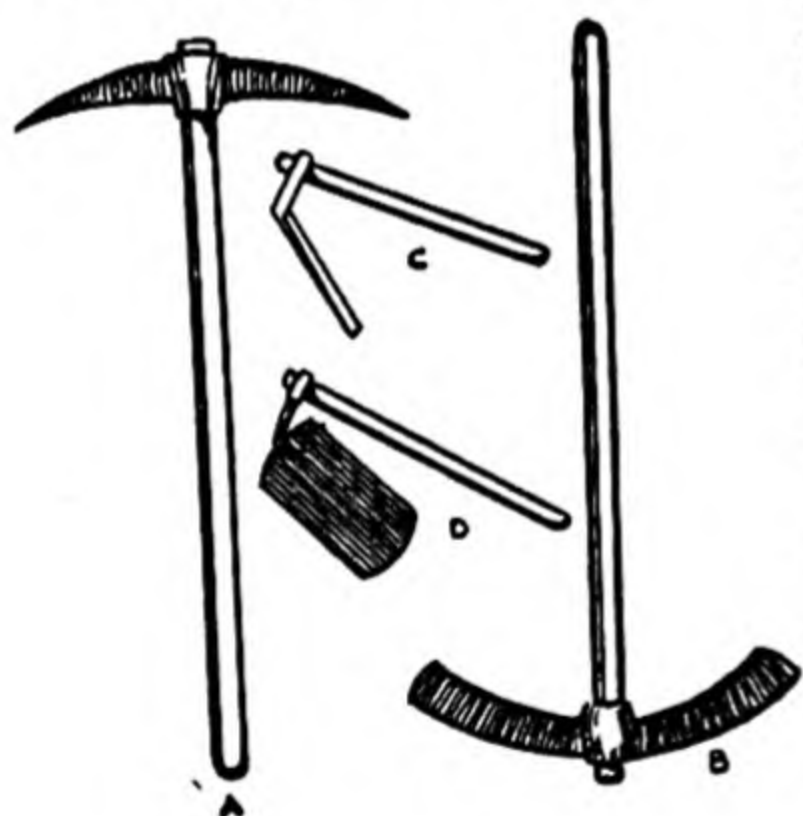


Fig. 20.

- A = Pick-axe.
- B = Mattock.
- C = 'Kothali' : 'Gudali'.
- D = 'Mamti'.

and the other is flat like a chopper, its edge being on a line with the handle. The 'pick' is serviceable to mend roads and

paths. The '*mattock*' is similar to the '*pick*' and has one of its ends broader than the flat end of the '*pick*'. The *digging*

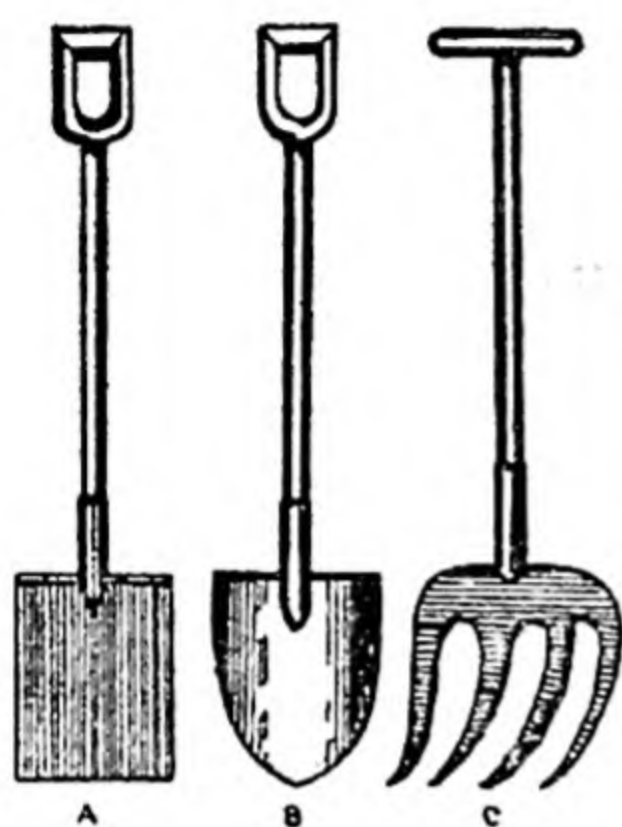


Fig. 21

- A = Spade.
B = Shovel.
C = Digging Fork.

fork has prongs about 9 inches long; it is furnished with a handle and the operator has to work it in an upright position as with the spade and the shovel. The fork is used for working stiff moist soils. Small *hand forks* are serviceable for transplanting small plants, for weeding and loosening surface soil. The *spade* has a broad blade of rectangular piece of iron, which is furnished with a handle. It is a very useful instrument for digging and trenching operations. The '*mamti*' combines the work of the spade and the shovel. The *shovel* resembles a spade with a curved blade and is used like the *mamti* for transferring soil, rubbish, etc., to baskets or turning them over from one position to another.

The *trowel* is a small instrument very useful for making holes for planting seedlings or small plants. The *dibber* is the instrument with which holes are made for planting or '*pricking*' seedlings.

Any round piece of solid bamboo or dried stem with one end sharpened not to a point by ending bluntly, would serve the purpose. But, if the point is shod with iron, it would last longer and enable the work to be carried out more easily.

The '*pillu-cheduki*' or '*varavari*' consists of a triangular piece of iron, fixed to a handle. It is mainly used for cutting the edges of lawns and flower beds and for weeding. The edge of the instrument can be sharpened as it gets worn out. The *edging iron* is the instrument for trimming edges of lawns abutting walks and roads and for cutting the edges of flower

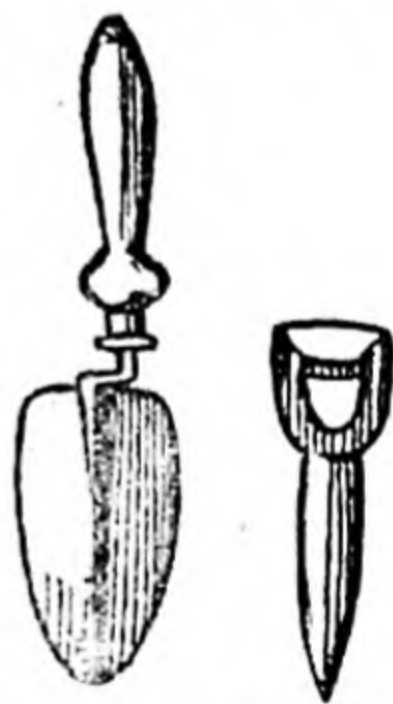


Fig. 22. Trowel. Fig. 23. Dibber.

beds in grass land. It consists of a crescent-shaped blade, with an iron socket in the centre, into which a long handle is inserted.



Fig. 24.

A = Edging-iron.
B = 'Vara-vari'.

The *rake* is an instrument for levelling land and to bring it to some uniformity of fineness by removing unbroken clods and stones. It is also helpful for collecting weeds, rubbish, etc., together in a heap before they are removed. The rake consists of a number of nail-like projections from a bar, furnished with a handle.

Fig. 25.
Garden rake.

The *bed marker* is easily made, as it consists of only a strip of wood into which are driven a number of strong nails at equal distances. This device is very handy when a large number of seedlings have to be planted out as it enables a large number of spaces to be marked out at one time. The *drill-maker*, consists of a board about

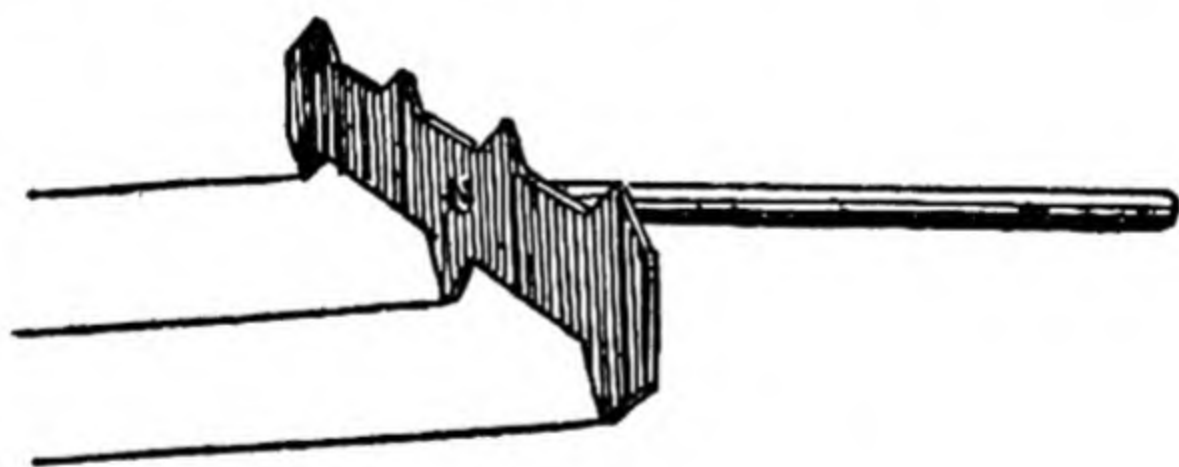


Figure of Drill Maker.

12 inches wide and $1\frac{1}{2}$ feet long, or more or less as needed actually, and cut with triangular projections and attached to a block of wood carrying a handle. By drawing the handle on the surface of the ground, the projections of the instrument leave depressions in straight lines in which seeds are sown.

A good *pruning knife* is a necessity for every gardener. It should have a strong curved blade. The *budding knife* is specially made. Its cutting edge is rounded off the point and

it is provided with a handle made of flat smooth bone or ivory, reduced to a spatula-like termination enabling easy lifting of the bark from the stock in budding operations. The budding knife should not be used for sundry work, as cutting small twigs, thread, mending pencils, etc. *Shears* are used for trimming hedges and pruning border plants. No gardener

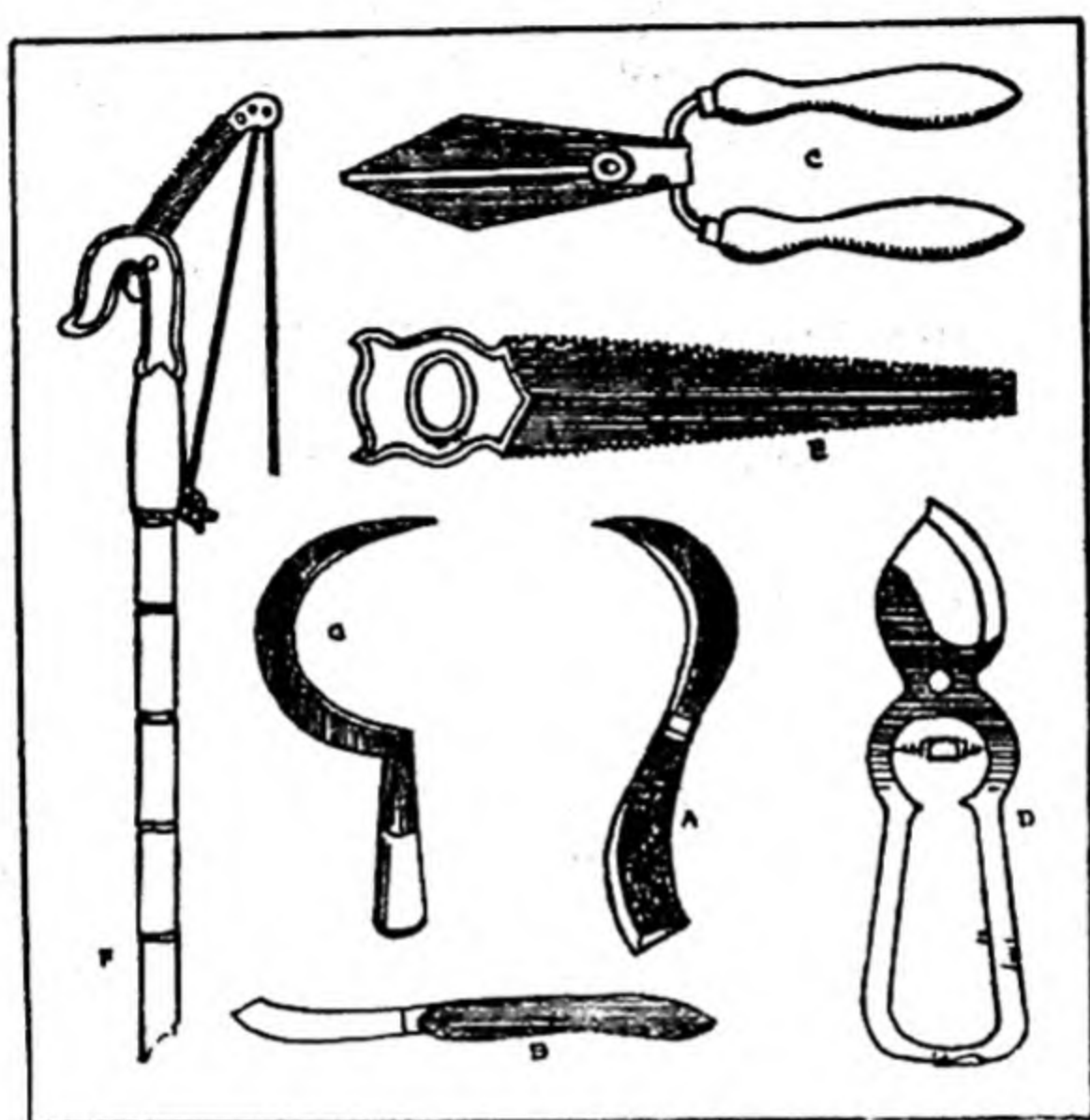


Fig. 26.

A = Pruning knife.

D = Secateurs.

B = Budding knife.

E = Pruning saw.

C = Shears.

F = Tree pruner.

G = "Kudugolu" like Scythe.

should be without a pair of *secateurs*. Only those types which cut clean without pinching first should be purchased. The 'Rollcut' secateur is one of the best kinds in the market. For pruning decayed and dead branches of trees and shrubs, a *pruning saw* should be secured. Small saws of the Grecian pattern with slightly curved edges are useful for removing branches which are inconveniently situated to be severed with ordinary pruners or secateurs. The *tree pruner* is provided with a long handle and is used to prune stray branches which cannot be reached ordinarily.

Baskets made of bamboo are for carrying rubbish, soil, manure, etc. Iron baskets or 'gumelas' are for the same use. A *wheel-barrow* is very serviceable to carry larger quantities of material with greater ease.

The 'mali' should be provided with suitable vessels for conveying water from the source to the plants. Galvanised



Fig. 27.

W = Water-can with rose (*R*) fitted on:
*R*₁ = Rose turned upwards giving spray of water with light or no force.
*R*₂ = Rose turned downwards permitting ejection of water with force.

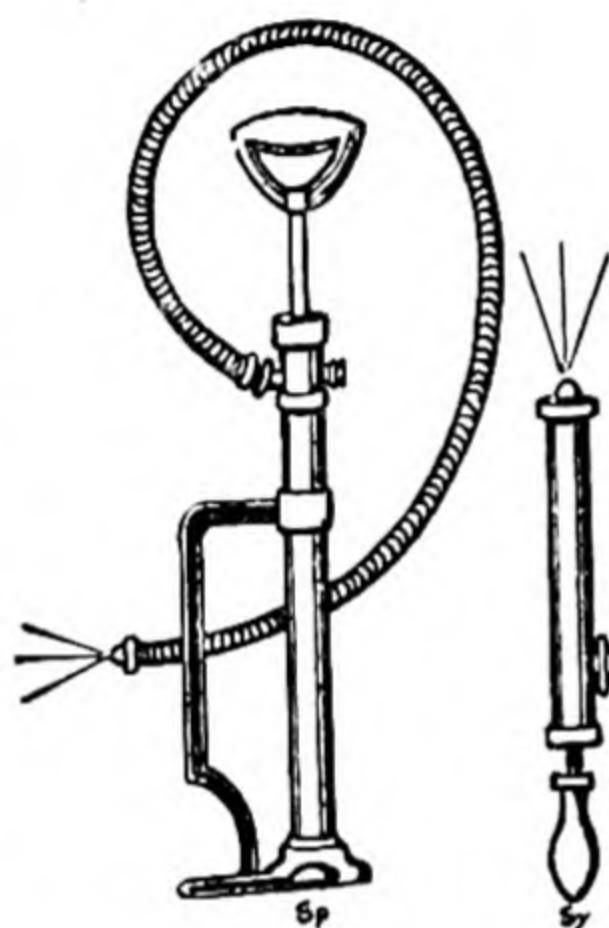


Fig. 28.

Sp = Sprayer.
Sy = Syringe.

iron pots are handy. A small tank or a barrel fitted with a tap and filled with water and carried over two wheels like the go-cart is serviceable as it will save the up and down trips of the 'mali' from the reservoir or source of water to the plants. A water-can with a coarse rose screwed or slipped on, is almost a necessity for watering pot plants. A fine rose should be fitted to it for watering very minute seedlings or pots in which very fine seeds are sown. The same fine 'rose' may be adjusted in two ways, allowing the water to come out gently in misty spray or with force. The water-can gives longer service, if it is coated outside and inside with thick paint.

For washing off dust from plants, one should possess a good *syringe* or *sprayer*. Syringes or sprayers are furnished with different sets of nozzles, which permit of water to be expelled in a fine misty way or in forcible sprays. The Abol syringe is one of the best syringes for all kinds of work in small gardens, being used for spraying insecticides, and fungicides as well. There are various forms of bucket and knapsack sprayers, useful for spraying large number of plants. A bottle sprayer is useful for spraying one or two plants only without waste of spraying material. A "powder gun" to dust insecticides and fungicides is also worth having.

Though the '*kudugolu*' and the *scythe* are useful for cutting grass, to avoid waste of time and to have the work done in an efficient manner, it is best to mow the grass on the lawn with a *lawn mower*. It should be carefully cleaned and oiled after use each time. The ground should have been properly levelled and all stones removed from the surface lest they should damage the blade. In the absence of a mower, a long straight edged sharp blade of iron fitted with a handle would be useful to slash grass on lawns. A *roller* should be owned if one is to have a good lawn. It would be useful for keeping the roads and paths in good condition.

Labels used for showing the names of plants should be neat, inconspicuous and durable. Zinc labels written with indelible ink are the commonest. Ivorine labels are costly but attractive. Deal-wood labels are cheap and handy. The portion which goes under the ground should be dipped in creosote, gas-tar, or any other preservative material. *Indelible ink* is made by dissolving 2 parts by weight of acetate of copper and 2 parts of ammonium chloride in 30 of water and adding 1 part of lamp-black.

In addition to those mentioned above, many other articles like the broom, thread, hose-pipe, ladder, crowbar, axe, hammer, scissors, grafting-wax and others too numerous to mention, are serviceable too, at one time or other.

CHAPTER VI

METHODS OF PROPAGATION OF PLANTS

Plant propagation: a fascinating pursuit : The power of producing young or multiplying themselves is a characteristic of all living organisms. All subjects of the vegetable kingdom, from the largest of trees to the lowest single celled plants, have some device or other for continuing their kind. The gardener, in order to enable himself to make new plants out of old, to replace the useless with the fresh and to increase his stock to meet the ever-increasing demands of a growing garden, should acquaint himself with the ways and means by which different kinds of plants can be increased. Plant propagation presents to him a fascinating aspect of gardening besides cutting short his expenses in purchasing plants and seeds. The pursuit becomes all absorbing, on account of new hopes and expectations raised, if the amateur gets a working knowledge of the elements of plant breeding and sets about creating new varieties.

Sexual and vegetative methods : There are various methods by which plants are raised, one or more of them being better suited to particular plants than others. But, all the methods followed fall under two heads :—(1) The sexual method, by sowing seeds and spores in the case of flowering plants and ferns respectively. Spores and seeds are the result of the union of male and female cells in plants. (2) The sexual or vegetative methods, which include such methods as by division, cuttings, layering, offsets, grafting and budding, proliferous buds or bulbils, etc.

It may be generally observed that plants raised by the sexual method are more vigorous growing than those raised by vegetative means. Seedlings may not take after the parent plants ; they may differ in the shape of the leaf, in the habit of growth, in the colour of the flower, or in some other characteristics from the parent. This is due to cross fertilization brought about by such natural agencies as wind, water, insects,

birds etc. But all plants raised by vegetative methods do take after the parent plant, unless it be that the particular leaf, or the shoot, or the root from which the new plant is obtained is a 'sport', having some peculiar fixable characteristics different from others on the same plant.

PROPAGATION OF PLANTS FROM SEED

Vigorous plants from seed : Reproduction from seed is the commonest method by which a majority of plants propagate. Cross fertilization and hybridization are responsible for the offspring of a plant by its seed not taking after the parent plant. Reproduction from seed is advantageous as it encourages vigorous growth, increasing the vitality of species, besides affording chances for obtaining new varieties. Constant reproduction by vegetative means tends towards degeneration of the species. But, it is the quickest mode of raising straight-away mature plants capable of blooming within a season or two. For instance, some Orchids take 8 to 12 years to bloom from seeds ; but, plants made by dividing old clumps or otherwise bear blooms during the same or the next season.

Secure best seeds : There is as great a difference in the vitality among seeds of the same as well as different species and varieties of plants as there is disparity in the strength and sustaining power of individuals composing mankind. The laws of heredity, such as the descent of healthy and strong children from healthy and strong parents, are equally true in relation to plant life. The aim, therefore, should be to secure the very best seeds, seeds which have been gathered only from mature or ripe fruits from healthy and vigorous plants, which have been marked out for conspicuous merits as the richness of their colour, the largeness of their blossoms, the luxuriance of their growth, the profusion of leaf or the shapeliness of form, etc.

Conditions for germination : Conditions essential for successful germination of seeds are heat, moisture and air. By heat is meant genial warmth, neither too cold, nor too hot for the plant. Generally seeds germinate better in closed frames, especially those which are furnished with bottom heat. In them, the soil is preserved uniformly moist and the hot bed

requires sufficient warmth for quickening the activity of the embryo in the seed.

Essential conditions for successful propagation: For successful propagation from seed, four essential conditions have to be satisfied. They are:—(1) The seeds should have been gathered from ripe fruits in an undamaged condition. (2) They should be preserved with care and not exposed to atmospheric moisture. (3) They should be sown in the right season and (4) They should be sown in the right manner.

Seeds, how collected and stored: Collection of mature seed presents some practical difficulties. Fruits which do not drop off before the seeds are ripe should be allowed to remain on the plant till they are perfectly ripe. Those kinds like Balsams, Crotons, etc., which burst their seed capsules scattering the seeds all over the ground, should be watched carefully and collected when they are about to burst, or better still, enclosed in paper bags. Others which have a tendency to drop off unnoticed, to all appearances looking green and unripe as in Calendula, should be enclosed in thin muslin bags for collection. Pulpy fruits like Tomato, Brinjal and Fuchsia, which ripen on the plant should be gathered when they fall off or show signs of over-ripeness, when they should be cut open and the pulp squeezed and washed with water separating the seeds, which should be dried in the sun. Seeds, with husks, should be gently rubbed in the hand and then sifted to separate the husk. Seeds which have been collected in the foregoing several ways should be cleaned, well dried in shade for two or three days and then in the sun for a couple of days and preserved in a cool dry place in sealed paper packets or in bottles or in tin boxes with labels on. A few crystals of paradichlorobenzene or a few pinches of naphthalene powder put into the containers will prevent seeds from insect attacks. Before sowing, seeds are best exposed to the sun for a couple of hours.

Peculiarities in germination: Different kinds of seeds have their own peculiarities regarding germination. The period of viability differs widely in different species. In most annuals, it is from 6-12 months. Most vegetable seeds retain their germination power for 2-10 years; Indian corn and parsnips

keep for about 2 years ; peas, beans, parsley for about 3 years ; brinjals, tomatoes, carrots for about 4 years ; lettuce, cabbage, musk melon, beet, egg-plant, celery for about 5 years ; cucumbers 8-10 years. Some kinds of seeds lose their vitality very soon. The mango, for instance, fails to germinate after 2 months. There are others, however, which are known to be active after several years. Some kinds of lotus are reported to have been germinated after 150 years. Even regarding the time taken for germination, there is much variance among different kinds of seeds. Generally, soft-coated seeds germinate in a shorter time than hard-coated seeds. Old seeds take a longer time to germinate than fresh ones. Some, as those of Pansy, sprout capriciously and irregularly. In some as in Cineraria, Petunia, Primrose, many of the choicest varieties do not germinate until long after the less attractive colours have produced strong seedlings ; for this reason, the smaller seedlings are not to be rejected while pricking or transplanting. Seeds of some kinds do not germinate well in certain seasons ; for instance, Larkspur and Nemophila do not germinate until the nights are really cool. The time to sow particular kinds of seeds is to a large extent related to its native home and ancestry. Seeds of some annual flowers, it might be observed, falling in the beds in which they were grown, get mixed with the soil and remain dormant in it to come up only in their proper season.

How to test seeds : In case of doubt, it would be wise to test seeds for viability before sowing them out on a large scale. A small quantity may be sown in the ordinary way in a small pot in sterilised soil and an idea obtained of the percentage of germination. This will decide the quantity of seed to be used for growing in the area fixed. The larger the percentage of germination, the less will be the quantity of seeds necessary.

The following is a simple seed-test, which may be made, indoors : Two small dinner plates are taken and boiled to remove any traces of fungi or spores of mould. Ten pieces of blotting or filter paper are cut to the size of the flat inner surface of the plates. The bits of paper are dipped in boiling water. Then, five of these disks of paper are laid on one of

the plates and on top of them the seeds are spaced out, 10, 50, or 100, according as the size of the seeds are large or small. The seeds are covered with the other moist disks of filter paper. The other plate is put upside down covering the first plate. The plates are removed to a slightly darkened warm room. The time taken to germinate will depend upon the kind of seed, varying from 3 to 10 days or more. If the seeds sprout, they should give good results.

Seed-sowing, how done : A number of details have to be borne in mind in sowing seeds :—

The soil for sowing should be light and porous. A mixture made up of one part each of loam and sand and two parts of fine sifted leaf-mould is the ideal soil for sowing. In the absence of leaf-mould, very well rotted manure may be used. Seeds are sown in specially prepared nursery or seed-beds or in seed-pans or seed-boxes.

A sheltered sunny situation away from trees is chosen for making nursery beds, which may conveniently be 3 feet $\times$ 2 feet or smaller according to the actual needs. If the soil is not



Fig. 29.
Soil leveller.

good, it is replaced to a depth of one foot with the soil recommended above. If it is good, it is dug up to a depth of about 15 inches, broken and made fine and even, and raised 2-3 inches above adjoining ground if necessary, for drainage or to prevent being flooded during rains. The top soil to a depth of 6-9 inches is well mixed with sand and sifted leaf-mould and levelled after picking out

all stones, rubbish etc. The surface is made fine and smooth, and then pressed down gently with the palm or better still with a soil-leveller, which is a plank attached to a handle, to get the full benefit of the capillary action of the soil particles, and watered some hours before sowing, in order that the soil may settle down. The seeds are sown in drills or broadcast thinly and evenly. Not only is much seed wasted by thick sowing but also the growths crowd each other with the result that the seedlings get lanky and spindly giving rise to inferior plants. The seeds are covered with

a mixture of fine soil and powdery manure or leaf-mould to the necessary depth, this being usually the thickness of the seeds themselves. Too fine a soil tends to cake and flake and if it does, the first young leaves of the young plant may not command enough force to push through it. Covering the seeds with coarse-grained sand is often preferred to fine soil, as it is less taxing to the sprouts and would ensure therefore a larger percentage of germination. Some charcoal dust added to the sand would be helpful in keeping down fungus attack. The bed is then watered with the 'rose' of a water-can, using a finer 'rose' for small seeds which are covered only lightly. To minimise evaporation from and to preserve the moisture in the soil, it is covered with shade. Bamboo thatties may be put over the bed at a distance of about six inches from the surface. The soil is kept moist by supplies of water when needed. After germination, more and more sun is daily allowed to the young seedlings, which are thus gradually hardened. The shade is removed finally after a few days. If seedlings are close together, they are thinned by pulling out some. They can even be transplanted, if too valuable to be thrown away, in which case they require to be removed with greater care, after wetting the soil sufficiently. Seedlings of most kinds are best 'pricked' (transplanted) to encourage growth of fibrous roots. If seeds are fairly large as those of Nasturtium, Balsam, Sunflower, it would be economical to sow them in drills, 2-6 inches or more apart as may be convenient and desirable, as the operation of thinning is confined to one direction and therefore reduced to a minimum. Seeds of hardy kinds which are smaller than the above, such as those of Aster, Pinks, Phlox, are broadcast, or better still, sown in nursery beds in small drills made by pressing down long straight round sticks about the thickness of a pencil into the soil, an inch apart.

Very delicate kinds of seeds are best sown in seed-pans or seed-boxes, as they can then only be managed easily. Very small and dust-like seeds as those of Lobelia, Cineraria, Gloxinia, Begonia are best sown in seed-pans or seed-boxes. Seed-pans are shallow earthenware pots, about 4 inches high and 14 inches in diameter at the top. Seed-boxes which are of wood are conveniently 16 inches wide, 24 inches long, and

3½–4 inches deep, with 6–8 properly spaced holes drilled in the bottom. Seed-pans have for drainage one large hole in the centre or 3 holes equi-



Fig. 30.

Seed-pan with Drainage.

distant from each other. Against each of the holes is placed a crock with its concave side down. Some large pieces of crock are put over and by the side of this crock at the bottom of the pan.

Over these again is put a layer of crocks broken up to the size of large pea or coffee seeds, the entire drainage material making a depth of about an inch. Some coarse sand, 2 or 3 handfuls, is sprinkled on

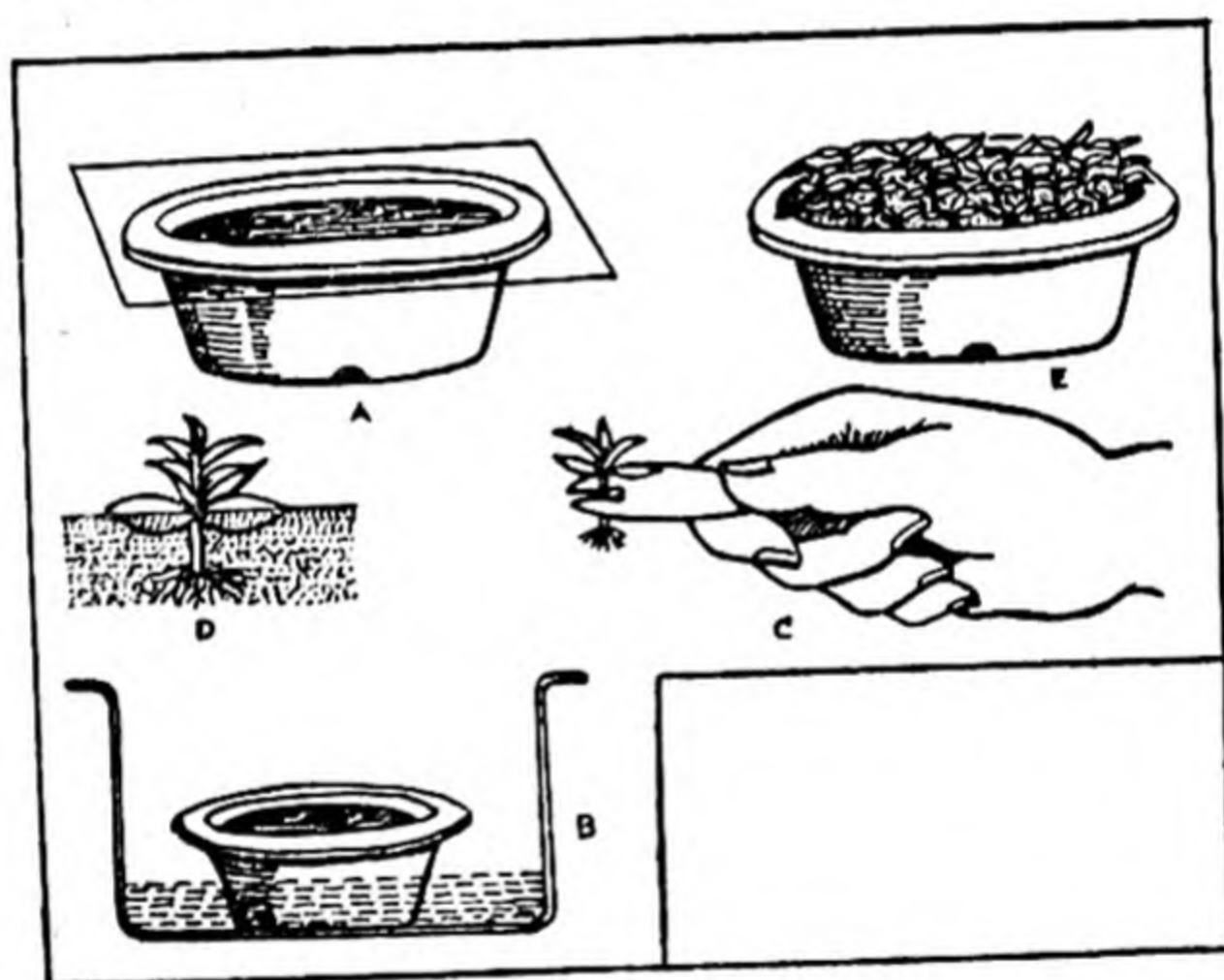


Fig. 31.

- A = Seed pan covered with glass plate after sowing.
- B = Shows manner of watering the soil from below.
- C = A tiny seedling taken out of the soil and held in the fork ready for pricking.
- D = Shows the depth up to which seedling is to be pricked
- E = A pan full of pricked seedlings.

the crock pieces forming a thin layer to prevent fine soil from clogging the drainage. The pan which is thus provided with efficient drainage is filled to half an inch from the top with

the soil mixture recommended above. After levelling it, it is lightly pressed down and watered with the 'rose' of a watering can. When the water has drained away, the pot is ready for sowing seeds in. The seeds are scattered on the soil, distributing them thinly and evenly over the entire area. They are covered, then, with fine soil to the required depth, which is generally the thickness of the seed. Again, watering is done with the rose, not disturbing the seeds and the covering soil. Very small seeds are best mixed with 8 to 10 times their bulk of fine sand to ensure even distribution while sowing. They have naturally to be covered lightly just hiding them from view. Seeds, much smaller than these, as for instance those of Gloxinia, Begonia and Fern spores, which are like particles of dust, are bulked as usual and dusted on the surface of the soil, and not covered at all. In the case of tiny seeds, watering is best done from below through the drain holes. For this, the pan is allowed to stand in a shallow basin of water, with the level of the water in the basin below the surface of the soil in the pan, till the water rises through the drain hole to the surface of the soil moistening it. After watering, the pan is covered with a sheet of glass to preserve the moisture inside, and removed to a shady situation. When the soil begins to get dry, it is watered carefully as before. Too much of water is harmful as it rots the seeds by excluding air. Any moisture collecting under the glass is wiped off every morning and evening.

Care to be taken of seedlings : Attention to a number of cultural details is necessary in the seedling stage of plants to enable them to grow into healthy, strong, and fruitful specimens.

When the seeds germinate and the seedlings show themselves out of the soil, the glass covering or the sheet of moist paper which is often used as a substitute for it, is removed. The seed pan or box is allowed more and more sun and air, except during the hottest part of the day. So long as the plants are not adversely affected by heat and light, the more sun they get the more thrifty and hardy they become. In too much shade the young plants become drawn out, thin and lanky.

The seed pan is placed in a position where it gets even

light on it. If light reaches the seedlings from one direction, they turn towards it, elongate, topple one over the other, spindle and die.

Great care is necessary in watering. Too liberally watered, the seedlings are apt to damp off. If the soil is allowed to get too dry, they shrivel and die. Just enough moisture to keep the soil just moist and no more is needed. Once the soil is wetted through by a liberal application, no more watering is done till the soil is just dry on the surface. Frequent sprinklings on the surface tend to keep the soil wet and sour above and very often dry below.

Seedlings are best watered early in the morning before they are put out in the sun. If they happen to need watering at any other time, they are removed to shade and watered after the soil has cooled down. Disregard to this small detail will result in the loss of an entire batch of seedlings.

If, in spite of the best care taken, seedlings do show a tendency to damp off, as could be seen by some of them turning brownish near the junction of the stem with the surface of the soil and their wilting and falling over, charcoal or lime or sulphur dust sprinkled over the surface of the soil or better still, a soaking of the soil with a dilute solution of chestnut mixture mentioned in chapter XI, will prevent further loss.

Living space is more necessary for plants than humans. This is provided by 'thinning' or by 'pricking'. When there are too many of them in a given area, they mutually shut off air and light from each other.

'Thinning' is done by pulling out some plants from crowded areas, after wetting the soil through, so that those that are left may enjoy more light and air.

The proper stage for 'pricking' or the first transplanting of young seedlings into new and richer soil with enough space to grow healthily till they are planted out is generally as soon as the first pair of true leaves are formed by them. In some cases, it is desirable to allow them to make some more growth before pricking.

The soil used for pricking is slightly richer than the compost for sowing seeds. Some well decomposed manure sifted through a quarter inch mesh is added to this. A

teaspoonful of superphosphate mixed with the soil for each box or pan will promote better root formation.

'Pricking' is done as follows :—The seed pan is watered. After about an hour, beginning from one edge of the pan, the seedlings are covered up with the soil held by the roots in small clumps. Each clump is gently pressed with the hand and broken up and the seedlings separated and individually taken out without damaging the roots. These are planted into the fresh soil in another pan or nursery bed. This soil should have been watered a few hours before. It is raised up and stirred to a depth of about 4 inches and lightly pressed down so that it is soft and mellow and not too dry, filling the holes rapidly as they are made for transplanting. Beginning from one edge of the freshly prepared pan and proceeding towards the opposite one, holes are made with the finger or dibble $1\frac{1}{2}$ -3 inches apart into which the seedlings are set. The more rapid growing plants are placed at greater distances apart than slow growing ones. The holes are just so wide and deep as to hold all the roots and the plant upto the level of the first seed leaves. This operation is done quickly so that the tender roots do not dry and suffer by exposure to wind and sun. After each seedling is put into the hole made for it, the soil is gently pressed under by the finger or the dibble so that it fills up the hole and comes in contact with all the roots of the little plant. If not, they would hang down in the air pockets in the holes, wither and die. The soil is then drawn towards the depressions for levelling.

Seedlings which are very small in size as those of Begonia, Gloxinia are best lifted with the help of a narrow thin flat piece of wood in which a small notch is made in the middle for holding the delicate plants, which are otherwise too small to handle.

Transplanting is done to increase the fibrous root system and make strong stocky plants. Some kinds as Asters, Pinks, are best transplanted twice before planting out. After each transplanting, the seedlings are removed to shade and carefully watered till they establish. They are admitted to more and more sun gradually and more liberally watered as they grow. They are thus 'hardened' or acclimatised to stand the rigours of life in the open, when they are planted out.

Special treatment in sowing certain seeds : The seed coat varies in its thickness and texture with different species. If it is thin, moisture soaks in and reaches the germ of the seed soon, stimulating it to germinate quickly. If it is thick and horny, moisture does not enter the seed for a long time, requiring some artificial aid to soften the shell to admit water inside. Hard coated seeds as those of *Canna* and *cassia renigera* or *C. nodosa* or *C. javanica* are best soaked in warm water and kept moist for three or four days before sowing ; they are often left coated with a paste of cow-dung and water for the same purpose ; they may be filed through, not injuring the embryo ; the method chosen in each case depends upon the degree of hardness of the seed.

Beware of ants : Where ants abound, seed pans and seed beds should be protected from them. They either carry away the seeds or damage them. Boiling water is poured over the soil before sowing to drive them away. Seed pans are best placed on stands kept in water.

PROPAGATION FROM CUTTINGS

What is a cutting : Next to seed-sowing, the commonest method of propagating plants is by cuttings. Any portion of



Fig. 32.

A = Geranium cutting.

B = The same after callus formation.

C = The same after emission of roots.

a plant, a piece of stem, leaf or part of a leaf, a piece of root or root-stock, which has been removed from a plant with the object of inducing it to strike roots and thus begin an

independent existence is called a cutting. Thus, there are stem cuttings, leaf cuttings and root cuttings. The sap accumulates at the cut end, forming a cellular thickening called the *callus*, from which roots emerge in course of time.

Multiplication by cuttings : Multiplication by cuttings is a cheap and convenient method of raising several kinds of plants. It is resorted to when seeds are unobtainable and when it is desired to keep a stock true to type. While cuttings of some kinds of plants emit roots readily, by mere contact with moist soil, there are others, which do not root at all ; again, there are others, which root with difficulty, requiring such aids as the propagating frame and the hot bed. Why plants differ so much in this respect is not known.

Kinds of cuttings : The following table, taken with some modification from Bailey's Standard Cyclopædia of Horticulture shows at a glance various kinds of cuttings which are employed to propagate plants :—

Cuttings :

(a) Stem	Growing wood	Soft, <i>e.g.</i> , Fuchsia, Coleus.
		Hardened, <i>e.g.</i> , Rose, Croton.
	Ripened wood	Long, <i>e.g.</i> , Poinsettia.
		Short, <i>e.g.</i> , Vine
(b) Roots or root-stocks		Long.
		Short, <i>e.g.</i> , Bread Fruit Tree.
(c) Leaf	Entire, <i>e.g.</i> , Echeveria, Saintpaulia.	
	Divided, <i>e.g.</i> , Begonia Rex.	
	Bulb scales, <i>e.g.</i> , some Lilies.	

(a) STEM CUTTINGS

Choice of cuttings : Cuttings are taken from healthy plant only. The nature of cutting that would successfully root varies in different kinds of plants. Generally very recent and tender growths do not make good cuttings, as they wilt and die for want of enough reserve material in them, besides being easily susceptible to fungus attacks. On the other hand, too hard and firm tissue has cells too dormant and inactive for fresh root formation. Hence, cuttings of moderately firm texture are utilised in generality of cases. When in doubt about the texture of the cutting which would give the best results, cuttings of

varying degrees of firmness could be tried for future guidance. As a general rule, there is a greater chance of cuttings of soft-wood taking root than of hard-wood. In the case of rapidly growing plants of good vitality, the proper condition for a cutting of soft growing wood may be determined by its readiness to snap, not bend, when bent back. Fuchsias are generally propagated by cuttings taken from the soft terminal portions of the growing shoots, with three or four nodes in them. The same is true of *Salvia* and *Coleus*. Geranium cuttings, if too soft, are liable to rot away; they should be hard and at the same time sappy. Some hardy trees and shrubs like *Ficus*, *Citharexylon*, *Drumstick*, and the *Milk Bush* are propagated



Fig. 33. A. & B.

A = A chrysanthemum cutting prepared and potted.
 B = A number of such cuttings prepared, inserted by the edge of the pot.

by long cuttings of ripened wood inserted in the open ground itself, whereas in the case of *Plumeria*, *Croton*, etc., shorter cuttings of 6 to 12 inches may be used. Cuttings of Grape vine are best taken from ripe wood, in 6 inch lengths, each piece possessing at least two buds. A cutting produces a plant very similar in health, habit, vigour, freedom to flower and fruit, in fact, in all details and conditions, to the parent plant at the time it is taken off it. Cuttings from strong and sturdy stems with short internodes furnish better class of plants than those taken from slender weak shoots with long internodes. Cuttings taken from 'water shoots' do not make very fruitful or floriferous specimens. Water shoots are those oversappy, overvigorous and overluxuriant growths which produce no or

comparatively fewer flowers or fruits and are easily distinguishable from others. The position of the cutting on the parent plant very often determines the flower-bearing capacity and the vigour of the resulting new plant. In the case of Carnations for instance, the cuttings from near the base of the plants are comparatively grassy producing more leaves than flowers in the plants raised from them; those from the middle portions of the plant result in vigorous floriferous specimens.

There is no fixed rule with regard to the length of the cuttings to be taken. It varies with different kinds of plants and with weather conditions; a longer piece is more liable to wilt than a short one. The average length of soft-wood cuttings is 1-3 inches. The average length of hard-wood cuttings is from 6-9 inches, as in Rose, Crotons.

Season for propagation from cuttings: While tender soft-wood plants can be generally propagated throughout the year by cuttings, it may be observed that some kinds strike root with greater ease at particular times of the year. As a general rule, the best time for putting down cuttings is about the commencement of the growing season of the parent plants. In the greater part of India, August and September are the best months for propagation from cuttings.

Medium for rooting: The best medium for cuttings to root in is fine pure river sand. In the case of hard-wood cuttings, the addition of a little red earth or loam to the sand makes the soil firmer and more retentive of moisture. There is no need for any kind of manure in the soil for cuttings. A large amount of decaying matter in the soil, in fact, retards root formation. The same soil should never be used over and over again. The soil should be well drained.

Kinds of stem cuttings: Stem cuttings are of 3 kinds, viz., terminal cuttings, cuttings with the heel, and node or joint cuttings.

Terminal cuttings are taken from the top portions of shoots. Figures 32 and 33 illustrate terminal cuttings. A clean slanting cut is made just under a node. The lower leaves of the cutting are snipped, not torn off, so that a bare stem is left for planting in the soil. The upper leaves, if too large, are reduced to half their length, to minimise transpiration.

Cuttings of plants with milky juice, as Poinsettia, Plumeria, Oleander, are washed before planting them; they have to be laid aside after preparation for an hour before insertion in the soil. Succulent cuttings as those of Cactus, Cotyledon, Pine-apple are kept by for 2 or 3 days before insertion; or, they may be put in sand, which is not watered for 2 or 3 days; under these conditions, they form a callus at the base, which prevents decay.



Fig. 34. A. & B.

A = Hard wood Rose cutting with heel.
B = Hard wood Rose, 'mallet' cutting.

Heel cuttings are lateral shoots which are pulled off the main stem. Very often, these are more successful than terminal cuttings. The rough oval surface at the bottom is smoothened with a sharp knife, trimming the rough wood and bark. As in terminal cuttings, the lower leaves are removed and the upper leaves are reduced in size.

Mallet cuttings with small bits of wood branch attached to them are similar to heel cuttings.

All kinds of stem cuttings are best planted as soon as they are severed from the plant. The wood should on no account be allowed to shrivel. If there is a likelihood of delay in planting cuttings, they may be kept in water or wrapped in moist cloth. Cuttings may be inserted in specially prepared beds or in pots. Distance from cutting to cutting may be

from 1 to 4 inches. Cuttings root with greater ease if they are placed very near the crocks or by the edge of the pot. A dibble should be used for making holes for inserting cuttings in the soil. The cuttings are placed in the holes and gently pressed down, taking care that their bases reach the bottom of the holes and rest firmly on the soil. The soil is well pressed round the cuttings. Firming the soil round the cuttings fixing them firmly is a point which is ordinarily overlooked with resulting failures.

Node cuttings : Thick, short-joined stems as in *Dieffenbachia*, *Alocasia*, *Anthurium*, *Dracæna* are cut into short lengths, each piece having at least one node and a bud and immersed in pure sand with the buds facing upwards, as shown in figure 35. If the sand is kept just moist, roots are emitted in due course at the nodes. Buds develop into young shoots which emerge out of the soil.



Fig. 35.

(b) ROOT CUTTINGS

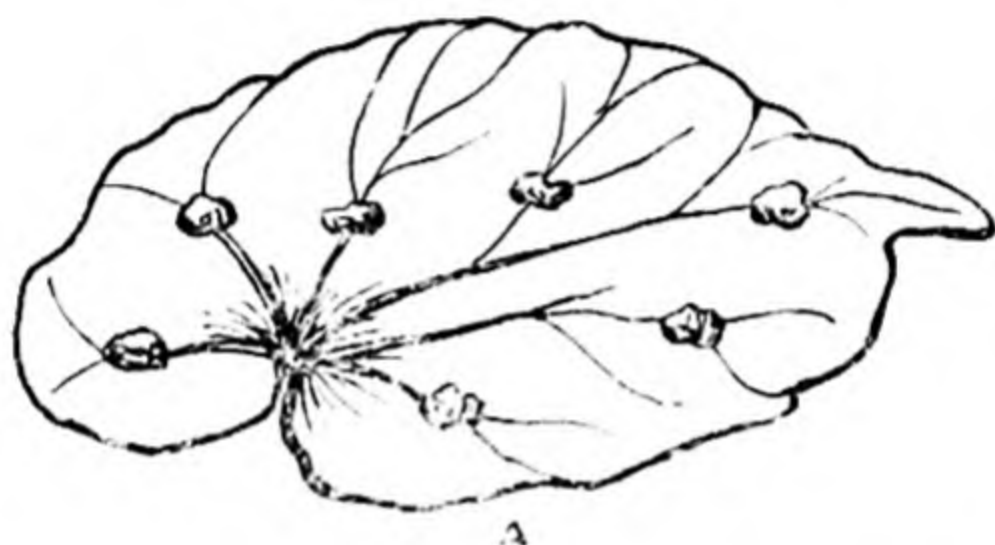
Some plants can be propagated from cuttings taken from the root, as for instance the Bread Fruit Tree. One to three inch pieces of lateral roots with one or more buds in them may be laid horizontally and covered with sand and firmed ; they may be planted vertically too, if they are more than three inches long. The soil to be used may consist of equal parts of sifted leaf-mould and sand.

(c) LEAF CUTTINGS

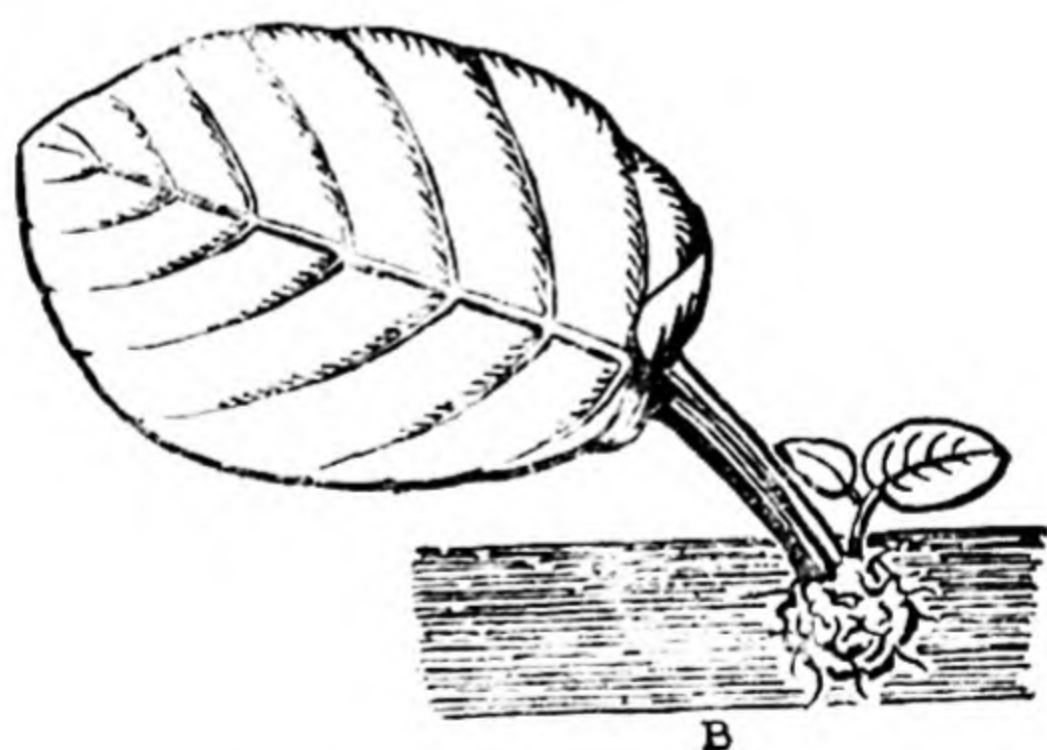
Propagation from leaf-cuttings is most advantageously practised with many plants as *Peperomia*, *Rex Begonia*, *Saint-paulia ionantha*, *Gesnera*, *Bryophyllum*, *Kalanchoë*, etc. Only mature leaves, which are not too old, are used. Young too tender leaves are not suitable as their energy will be employed in making their own growth and not for forming roots ; old leaves are likewise not suitable as they would have already exhausted themselves in the performance of their functions. The entire leaf or only a part of it may be used as a cutting,

the method varying with the kind of plant. *Peperomia* is propagated by cutting back the leaf-stalk to about half an inch in length and inserting it in moist sand with the blade above. *Bryophyllum* leaves develop plants all round their edges if laid underside downwards on moist material. *Rex Begonias* may be raised by immersion of leaf-stalk in moist medium as *Peperomia*; entire leaves with stalks removed, laid on moist sand with the large veins notched or cut and pressed into the soil by small pinches of soil above the cuts, as shown in figure 36 A, produce young plants at all the notches.

Fig. 36.



A = Leaf of *Rex-Begonia* with its petiole stuck into soil and its blade resting on it with the cut veins weighted down with pinches of soil put above.



B = Shows how a *Saintpaulia* leaf emits roots and forms a young plant.

Care to be taken of cuttings: After putting down the cuttings in pots, they are removed to a cool, shady, sheltered

situation. The nursery beds are shaded if the cuttings are put into them. The cuttings are then watered moistening the soil through. While watering, they should not be shaken or disturbed and so it is advisable to do the watering with a water-can fitted with a fine 'rose'. The soil should not be allowed to get dry at any time and so is kept moist by necessary applications of water. It is to be remembered, however, that overwatering resulting in stagnation of water round the cuttings will cause them to rot.

Aids to formation of roots by cuttings : Cuttings lose water by transpiration and expend energy, sap and reserve food substances in them in the process of forming roots. Till they emit roots and are able to draw nourishment and water from soil and air, they have to be maintained alive. Root formation is stimulated and hastened as follows :—(1) By minimising loss of water by transpiration by surrounding the cuttings with a humid atmosphere by syringing them with water as often as necessary or better still by keeping them in a closed atmosphere as inside a bell-jar or a propagating frame and admitting fresh air into it when it is taken out for wiping off water from the glass every day. The bell-jar or the propagating frame serves also to maintain uniform temperature for the cuttings. (2) By providing "bottom heat" for the cuttings. The temperature of the soil kept agreeably higher than the superincumbent air, stimulates the flow of sap to the bottom of the cuttings resulting in speedier formation of callus and roots than otherwise. Bottom heat is generated by a 'hot bed', as described elsewhere, or by heating the soil uniformly by suitable electrical means. (3) By treating the cuttings with a plant growth substance or auxin.

Plant hormones : Hormones are substances which are formed in the thyroid, pituitary and such other glands and which stimulate or influence the vital functions of other human organs to which they are carried by the blood stream. The leaves in plants form a substance which passes down the stem to the roots where it regulates their growth. Likewise, the roots form a substance which is conveyed up the stem to regulate the growth of shoots. These growth-regulating substances or plant hormones are called auxins. Evidence has

been obtained by scientists that auxins which promote growth in shoots and which stimulate root formation and growth are identical. The ability of a cutting to strike and establish itself as a separate plant is due to the presence of the root forming hormone in its tissues.

It is extremely difficult to isolate plant hormones. In 1935, a substance was prepared from urine which acted in the same way as a plant hormone. It was later found to be identical with indole-acetic acid. Other synthetic preparations as indolebutyric, naphthalene acetic, indole-propionic acids are found to have similar effects upon plants in promoting root formation and evoking other growth responses too.

The knowledge of the presence in urine of herbivorous animals and probably in humus also of growth-promoting substances strengthens our belief in the importance of dung manure and humus and their superiority over inorganic fertilizers for growing plants.

Various alcoholic compounds or pastes or powders containing one or other of the above mentioned synthetic preparations are put in the market under different names—to mention a few—'Auxilin', 'Hortomone', 'Hormodin'. A new and simple technique in striking cuttings of many kinds has been made possible by the use of these products, which are sold with complete instructions. The solutions or pastes or powders are harmless to cuttings and are effective only in very low concentrations of the auxins, as low as 1 to 4 parts of them in 100,000 parts of water.

The following is the procedure adopted in the case of Auxilin :— The cuttings are taken and their basal ends immersed in a water solution of Auxilin to a depth of $\frac{3}{4}$ –2 inches, the strength of the solution varying with different kinds of plants and made up according to detailed instructions. The cuttings are allowed to remain in the solution from 4 to 48 hours. After this time, the cuttings are washed in fresh water and planted in the usual way. They form callus and emit roots more rapidly and more freely than untreated cuttings and hence make better plants than the latter.

In the case of proprietary powders the bases of the cuttings, after being moistened with water, are dipped in the powder

and kept by for some time and then the powder is washed off and the cuttings inserted in striking medium.

Potting rooted cuttings : Cuttings of all kinds are allowed to remain in nursery beds or in pots, until they strike roots. As soon as growth commences, the rooted cuttings are potted separately, the size of the pot to be employed depending upon the quantity of roots on the cutting. It is always advisable to begin with smallest sized pots and to increase the size at each shifting or re-potting. For the first potting, the soil should contain a large quantity of sand and leaf-mould and very little of manure, which should be in well decomposed state.

Propagating or cold frame : The need for glass frames and hot beds for securing suitable condition for propagation by cuttings has already been emphasised. A propagating frame, in some cases with, and in some without the aid of a hot bed,

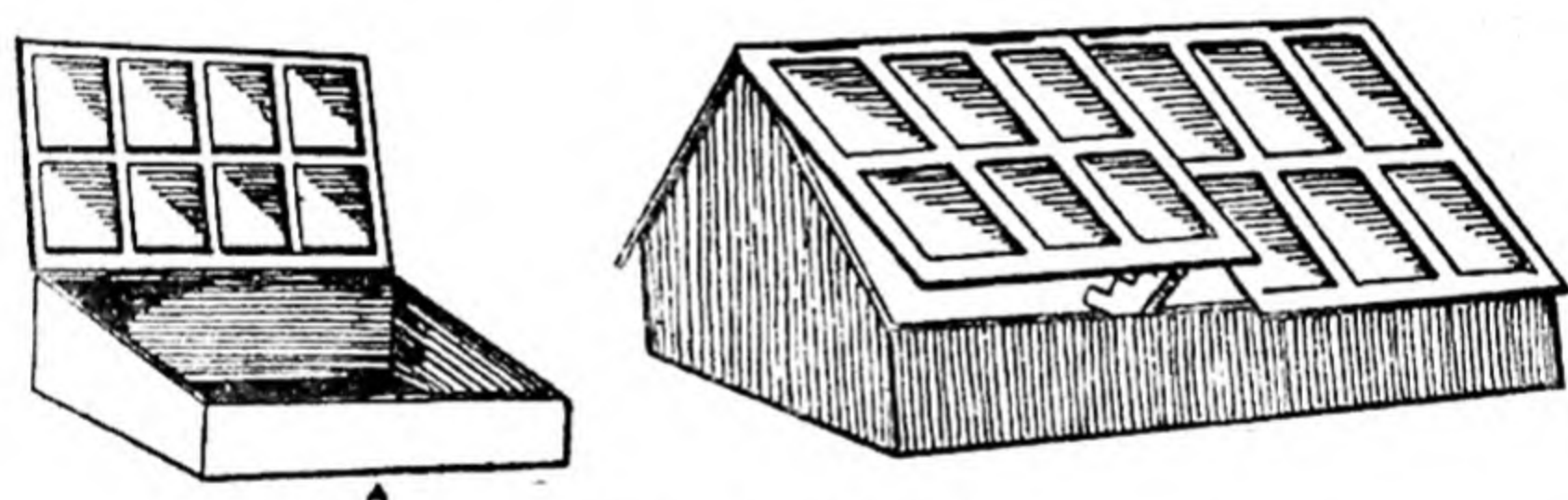


Fig. 37. A. & B.

Two types of propagating frames.

is quite indispensable for raising several kinds of plants from cuttings which do not strike roots without some device for preserving a warm and humid atmosphere around them, while at the same time allowing sufficient light for growth. A frame is an absolute necessity in a garden of any pretensions to size, where a large number of various kinds of plant have to be continually raised. It is advisable to set apart a place in a remote corner of the garden for one or more frames. They have to be placed in a shady situation, where they get only morning sun for an hour or so in hot places and in a sunny situation in cold regions. The frame may be fixed or movable. The fixed type consists of masonry walls on the sides with

a covering of one or more glass sashes. These should be light and of convenient size to be handled by one person. The size of a frame can conveniently be 6 feet long, 3 feet broad and 2 feet high. The roofing may be lean-to or gabled, proper slope being given to the roof in either case to drain off all rain water. The sashes may be adjustable at different angles to admit air into the frame, whenever necessary, by allowing them to rest on detachable stays. Frames erected in sunny positions are to be provided with awnings or 'thatties' to screen off severe rays of sun. The ground on which the frame is put, should be trenched, well drained and filled to a depth of $1\frac{1}{2}$ feet with silver sand. Portable frames do not differ much from the fixed types, except they have sides made of wooden planks, tightly jointed and resembling a box without a bottom.

Hot-bed : A hot bed is a mass of properly prepared manure placed outdoors with a glass frame placed on top of it. Fermenting manure generates heat, which is utilised to quicken germination of seeds and formation of roots by cuttings and force the growth of plants. A hot bed is made and managed in the following way :—The staple material in the formation of hot bed is fresh horse dung—not more than twenty days old. To this is added an equal quantity of freshly fallen leaves, lawn mowings, etc. If any part of the dung is dry, it is watered; the whole heap is turned over every other or third day for ten or fifteen days, moistening the portions of manure which might have been rendered dry by excess of heat evolved during its decomposition. When the manure ceases to heat up much, it may be considered safe for making the bed. Excessive heat of decomposition is disastrous to tender roots. The addition of leaves has the effect of ensuring a moderate and lasting heat, which would not be possible if only horse manure is used. A suitable place, as dry as possible, is selected in a sheltered situation. A hole is dug in the ground about $1\frac{1}{2}$ feet deep and 1 foot longer and wider than the frame. Into the hole is spread the fermenting material, layer after layer, beating down each layer firmly before another is put on top of it. The material is put evenly so that it may not settle down more in one place than in another. The frame is then put in position

and more dung mixture is firmed as before, so as to occupy a depth of 6 inches above the ground. Very often, the total depth of material used is 3 feet. A 3-6 inch layer of sand is spread on the manure and the frame is closed. A stick, about $2\frac{1}{2}$ feet long may be stuck into the centre of the bed to serve as a guide for testing the heat. Much heat is developed and rank steam is evolved which is let off by opening the covering. In about a week's time, the temperature falls, and is 10 to 20 degrees higher than the shade temperature outside, when the hot bed is in a usable condition. Each day, the stick can be withdrawn from the bed and tested by clasping near the bottom with the hand; if it is violently hot, the bed is not fit for use and needs further cooling down; the bed is not considered safe for use till the stick can be held comfortably. Pots containing cuttings may now be immersed in the sand in the frame. The soil soon reaches the temperature of the hot bed. The frame is opened every day, both morning and evening, to allow fresh air; the sashes are wiped on the inside to remove moisture; the cuttings need watering only once in three to seven days as moisture is preserved in a closed atmosphere. Seeds may also be sown or cuttings inserted in the soil direct. The hot bed will keep its heat for a couple of months. Rooted cuttings or seedlings, as the case may be, are taken out of the hot bed and placed in a cold frame (that is, one without a hot bed in it) or in shade for a few days and thereafter gradually hardened to open air conditions.

PROPAGATION BY LAYERING

In the words of Lindley, "Laying (Layering) is nothing but striking from cuttings that are still allowed to maintain their connection with the mother plants, by means of a portion, at least, of their stem." Some plants, which are difficult to raise by cuttings, may be successfully propagated by layering. In layering, advantage is taken of the fact that the sap returning from the higher regions of a plant to its roots is capable of forming roots at any place of suitable texture in the stem, constituting a separate and independent plant, which may afterwards be detached from the parent.

Though in some cases, as in *Verbena*, roots are emitted from almost every node by covering the shoots with moist soil, it is generally necessary to interrupt the flow of sap downwards to induce formation of roots, by one of the methods detailed below, some one method being better suited than others in the case of particular plants:—

(1) *By bending, twisting and strangulation*: A healthy branch is bent into the form of an arc and pressed into the soil and held in that position by means of a small stone put on the bend or by means of a hook. *Jasmine*, *Oleander*, etc., are propagated this way. A little twist of the branch at the bend or strangulation of it effected by tightly tying a wire round the stem hastens root-formation by interrupting the flow of sap at the bend.

(2) *By tongueing or heeling*: A branch of well ripened wood that will bear being bent down to the ground or to the

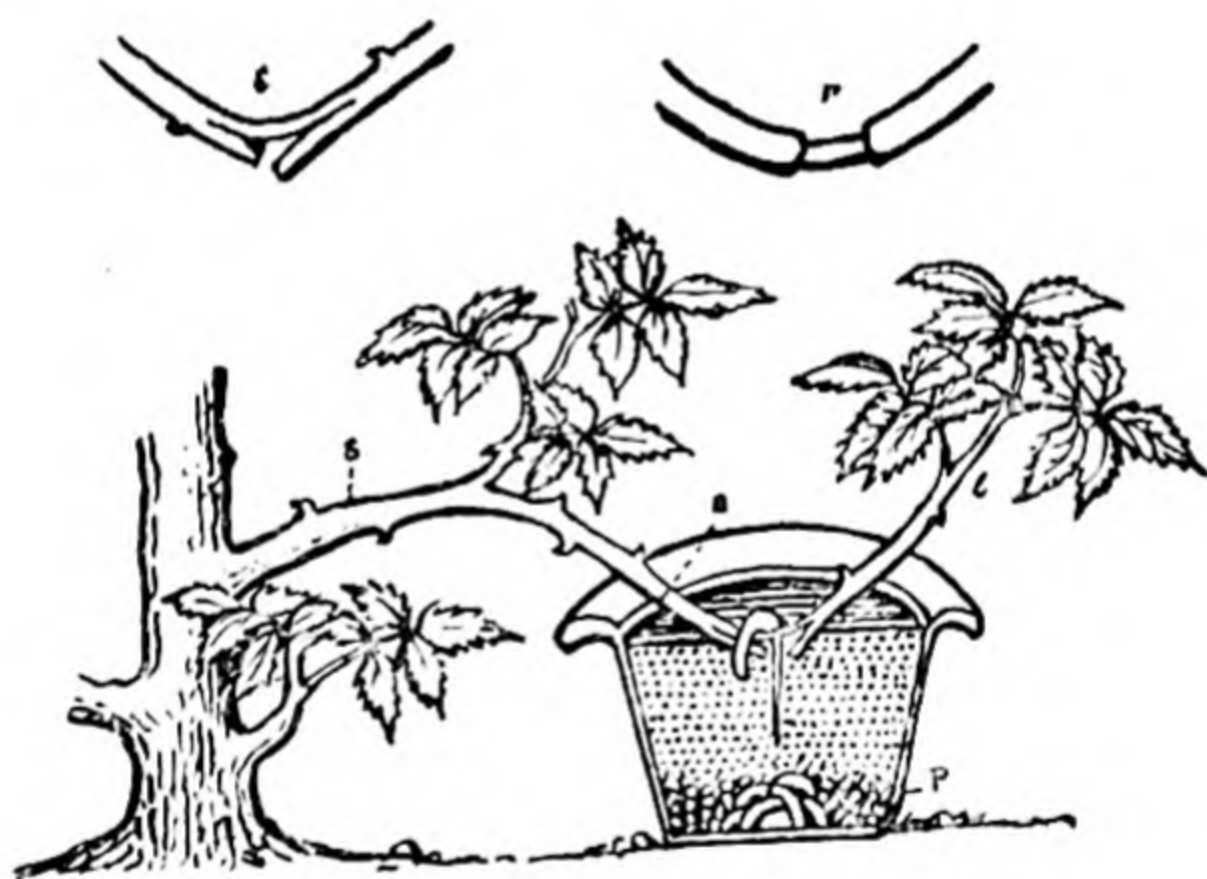


Fig. 38.

Shows manner of layering a branch.

S is the branch, a portion of which '*l*', is layered into the soil in the pot '*p*' by making a tongue as in inset '*t*' or by removing bark as in inset '*r*'. On the stem '*a*' is the place where the notch is to be made later on.

soil contained in a pot is cut half way through with a sharp knife just under a node by passing the knife upwards forming

a slit, $\frac{3}{4}$ – $1\frac{1}{4}$ inches in length, the length of the slit varying in the case of different plants. Thus, a 'tongue' is formed and it is kept apart from the other part of the stem by inserting a piece of match-stick or crock or similar material into the slit. All leaves are removed from the portion which would go under the soil. The soil for layering should be porous and may consist of sand only or preferably a mixture of leaf mould and sand. The prepared branch is bent into this soil, which may be in the ground or contained in a pot, and gently pressed into it without breaking, in such a way that the tongue enters the soil vertically.

The layered portion of the plant is then covered with soil which is well pressed round it. The shoot itself is held in position firmly by a hook driven into the soil as shown in fig. 38 or by the weight of a small but heavy piece of stone, as shown in fig. 39. Callus forms at the tip of the tongue, from which roots are emitted in due course. The time taken to root varies from 3 weeks to 3 months or more in different kinds of plants. When the callus is formed, which generally takes 2 or 6 weeks or even more, a small notch is made on the parent stem above the layered portion, further interrupting the flow of sap to the layered part of the plant. The notch is deepened gradually, as more and more roots are formed, every week or fortnight, till the layer is severed from the parent plant. Roses and several other shrubs and trees are increased by this method. Even such tender plants like Carnations can be increased by tongue layering.

(3) *By ring-barking* : Just under the node selected for rooting, the knife is passed round the stem, cutting through the bark; $\frac{1}{4}$ to $\frac{1}{2}$ inch below, another cut is made all round the stem in the same way. The bark between these circular cuts on the stem is removed, exposing the wood. See inset 'r' in fig. 38. Soil is then packed round the part so operated upon. Crotons and Dracænas are propagated in this manner.

(4) *By serpentine layering* : Serpentine layering is well suited for making a number of plants from a long running branch or shoot, as in creepers. As seen in fig. 39, the same branch is layered in a number of places, giving rise to a number of independent plants, when each rooted portion is separated

from the parent at points crossed by the dotted lines 'a' in the figure.



Fig. 39.

Illustrates serpentine layering.

(5) "*Stem layering*" or "*gootying*" : Stem layering is done in the case of tall stems, which cannot be conveniently



Fig. 40.

Illustrates gootying :
Inset shows the portion operated upon.



Fig. 41.

A pot plant, such as a Croton,
with its long shoots gootied.

bent down. Terminal portions of upright branches are stem layered. It is done as follows :—A healthy branch with well ripened wood is chosen. The stem is cut half way through, just under a leaf or leaf-scar, where it is desired the stem should root ; then, it is slit upwards for an inch or so, as in separating

a tongue, described above. The cleft is kept open by a small pebble. In some cases, as in crotons, the stem is ring-barked at the desired place as described above instead of making a tongue. The soil for rooting is held in position round the part of the stem operated upon by a piece of gunny bag or cocoanut-fibre cloth or moss and bandaging it tightly, as shown in figures 40 and 41. The soil is kept moist by applications of water. The following device ensures continuous soil moisture. An earthen pot with a small hole made in its bottom is suspended by its neck over the ball of earth as seen in figure 40. A clean knot is tied at one end of a piece of cotton thread-rope and the other end is passed through the hole in the pot, and drawn out till the knot lightly blocks the hole. The rope is then wound round the gunny bag and

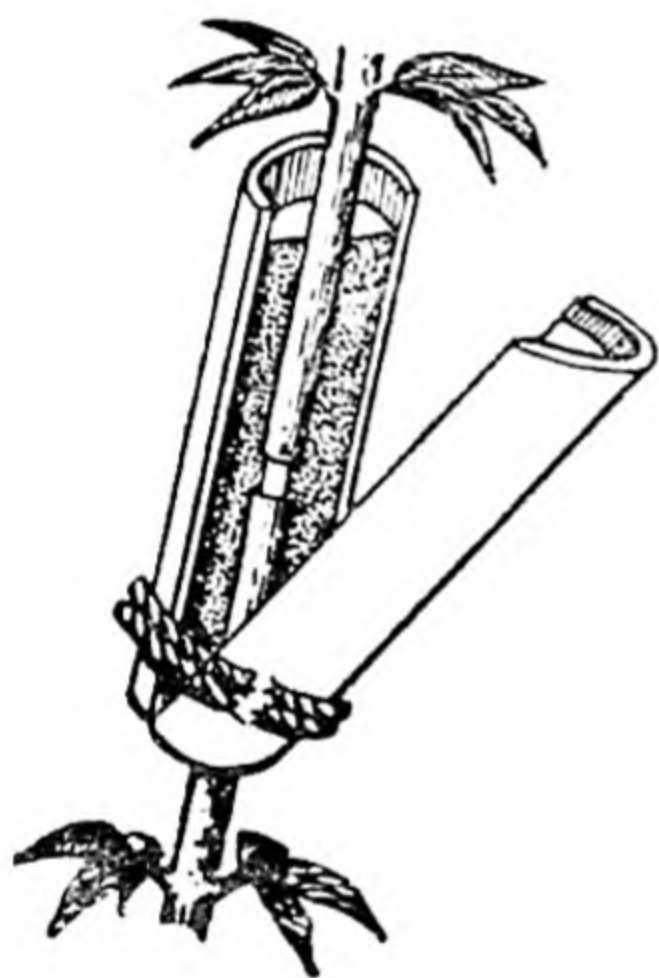


Fig. 42

Gootying with a bamboo receptacle for holding soil.

firmly tied. Water is poured into the pot, it passes slowly through the cotton rope to the ball of earth, keeping it moist always. This device is very helpful in the case of plants, the shoots of which take several months to root and are so high up that they cannot be reached easily for watering. The pot is filled with water as often as necessary. A notch is made just below the ball of earth every two months, till the stem is separated from the parent finally. The method described above is known as 'gootying.'

In place of the gunny bag, bamboo receptacles or two halves of a 4-inch pot may be used as shown in figure 42 to hold the soil round the stem. A close-jointed hollow bamboo with an internal diameter of about three inches is cut into several bits under each joint. The bits are then split in the middle, the two halves of each bit forming a receptacle for holding soil. The centre of each bit is cut semi-circularly to admit the stem when the halves are

brought round it. After the stem is operated upon as described above, the halves are brought together round it, keeping the cut portion about the centre of the vessel; the halves are tied together firmly and held in position by a small piece of stick tied crosswise to the stem. Into the bottom of the vessel are put a few pieces of charcoal or coarse sand, to close the crevice round the stem, if any, to prevent soil from running out. The vessel is then filled to about half an inch from the top with sand which is kept moist by supplies of water when necessary use of Polythene film is a good substitute for gunny, as it retains moisture for months and rids of the labour of watering daily.

PROPAGATION BY DIVISION OF SUCKERS, OFFSETS, RHIZOMES, ETC.

Plants growing in clumps such as Chrysanthemum, Michaelmas Daisy, Violet, Amaryllis, Tuberose, etc., consisting of old plants surrounded by smaller ones, are easily propagated by division.

Suckers: Some plants form clumps with suckers from the stem or from the root or from both. Stem suckers spring from the base of the stem below the surface of the soil. Root suckers arise out of adventitious buds formed on roots; these may be close to the stem or away from it. All suckers grow at the expense of the parent plant, getting their nourishment from the latter till they themselves develop roots and are able to start independent existence. Division of clumps is



Fig. 43.

A runner. Young plants separated at 'a' are started separately.

usually effected at transplanting time. Care is to be taken that the roots are damaged as little as possible. The outer pieces or parts are selected for replanting, as they produce more vigorous and floriferous plants than the parent plant at the centre which has exhausted itself. Each rooted sucker, planted out or potted suitably, is capable of furnishing a plant.

Runners: Runners are prostrate stems rooting at the joints as they creep along. The runners are cut close to the

parent plant and started independently. The strawberry is propagated by runners.

Bulbs: Bulbs, some kinds in large numbers and some in a limited number, produce little bulbs exterior to themselves

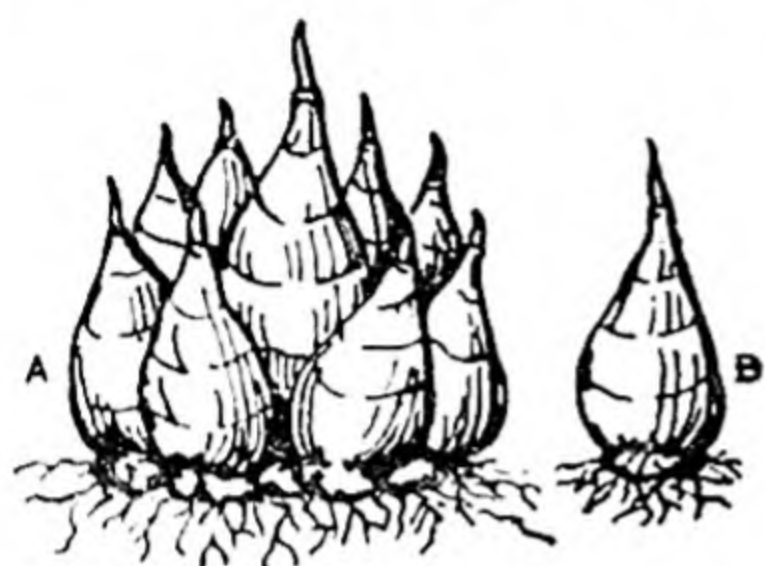


Fig. 44.

Tuberose with offsets.

round their base, as in *Amaryllis* and the *Tuberose*. These smaller bulbs (offsets) are separated from the old ones and started individually. Some bulbs which do not freely produce offsets are injured at the core, for instance by cutting out the growing bud; then they produce offsets, from which they can be increased. In some other kinds, as in *Crinum* and *Pan-*

cratium, the flattened base is cut into three or four parts to give rise to bulblets, which are then separated and transplanted.

Corms: Some corms like the *Gladiolus* produce spawns which are small corms or offsets, as in bulbs, which can be grown to bloom in one or more seasons. Others like *Caladiums* are propagated by the eyes or buds which are formed on



Fig. 45.

Corm of *Gladiolus* with spawns.



Fig. 46.

Potato tuber with its eyes, the dotted lines showing where cuts are to be made.

the old corms. Those eyes or buds are cut away with a portion of the old corms and started independently.

Tubers: In the case of tuberous-rooted plants like the *Potato*, large numbers of tubers or underground swollen stems,

bearing buds or node-like scars, are produced ; each of these is capable of giving rise to a new plant. The tuber is divided

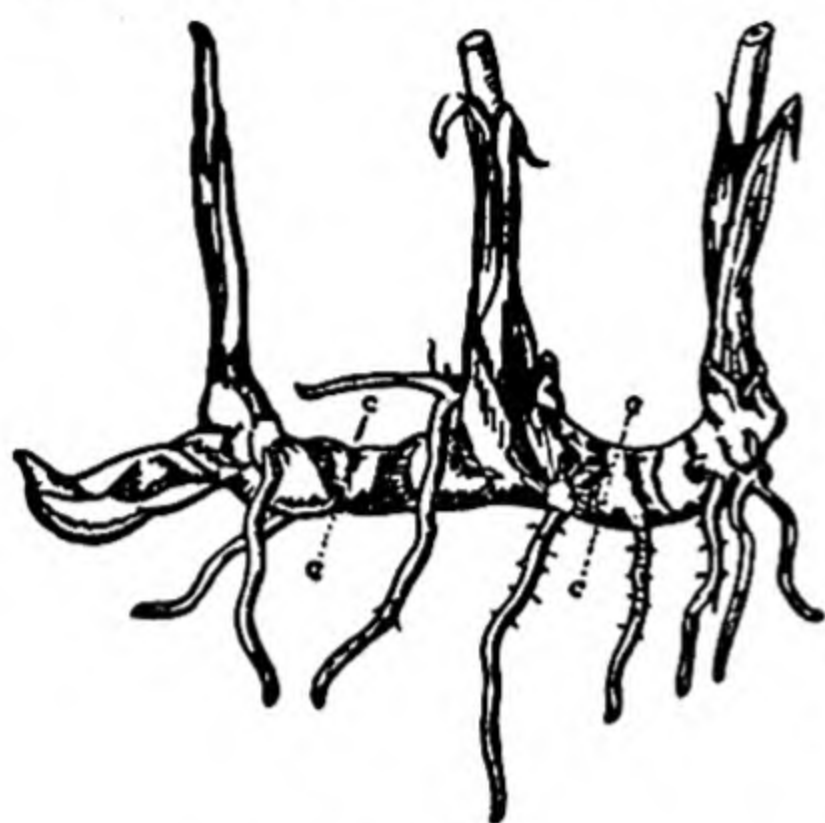


Fig. 47.

Rhizome of Canna.

into several parts, each part having an eye or bud or sprout, in addition to a portion of the fleshy stock. Dahlias do not really bear tubers. Their roots are fleshy and contain much reserve food for use during the next growing season and they are attached to a condensed part of the stem or crown bearing one or more buds. Thus, Dahlia clumps are so divided that each piece separated has

a part of the crown with at least a bud in it.

Rhizomes: Rhizomes are creeping underground stems, producing aerial shoots from buds above and roots from below. The Canna is the best example of a rhizomatous plant. It is raised by cutting the rhizome into bits, each bit having a bud in it.

PROPAGATION FROM PROLIFEROUS BUDS AND BULBILS

Several plants produce "aerial offsets" in the axils of leaves or on flower stalks or on leaves as on the fronds of certain Ferns, which are all capable of giving rise to new plants ; they often drop off the parts of the parent plant to which they are attached when fairly mature, and look like veritable youngsters. They are independently started in small pots or sown like seeds in seed-pans and then transplanted. Agaves produce a number of young Agaves, called bulbils, on their flower stalks, like seeds. Several varieties of *Anthericum* produce on their flower stalks, young plants which develop roots, from which they can be propagated. Ferns like *Asplenium bulbiferum* produce babies in the form of nodules on their fronds. These, when mature, can be started as young plants in small pots. The entire frond may be laid in moist soil, giving rise to a number of plantlets, from every nodule after it strikes root.

PROPAGATION BY GRAFTING

Graft. Scion: Grafting is an operation in which two cut surfaces of the same or different plants are so placed as to unite and grow together. The plant or the part of the plant on which grafting is done is called the *stock*. The part of the plant which is inserted in the stock or grafted on to it is called the *scion* or the graft.

Purposes of grafting and budding : Grafting serves several purposes :—(1) It is generally done to perpetuate and multiply varieties of plants which have been endowed with particular qualities and which cannot be transferred with any degree of certainty to their offspring from seed or which cannot be easily or speedily propagated by any vegetative means as from cuttings and layers. Orange and mango seedlings, for instance, may turn out to be inferior to the parent kind.

(2) By using hardy disease-resisting stocks thriving in particular climate and soil conditions, any species which does not thrive under those particular conditions, can be grown successfully as a graft plant. For instance, loose-jacket oranges, grown on their own roots, die of die-back disease after some time, in particular soils. But the same oranges grafted or budded on seedlings of 'jamburi' (rough lemon) are longer lived. Similarly, in the case of Apples, blight-resistant stocks as the Northern Spy are always used. (3) Weak growing species grafted on vigorous growing species are very often benefitted by a communication of vigour from the stock to the scion, (4) Grafts are often made to obtain rapid results. For instance, the Sapota takes 8-10 years to fruit from seed, and only 2 or 3 years from a graft. (5) Though generally, it might be observed that the stock and scion retain their individuality in the graft plant, it is true that in some cases, the stock has a decided influence upon the scion in producing some radical change, as for instance in rendering it more dwarf, more floriferous or fruitful, or in making it produce fruits of better or inferior quality or flavour. The 'Paradise' stock is used for dwarfing Apples. Pears are grafted on Quince roots for the same purpose. Thus, stock selection is of very great importance in fruit industry. (6) Grafting is

sometimes useful as a reparative process, as in bridge-grafting, supplying new tissues to connect parts which are separated by

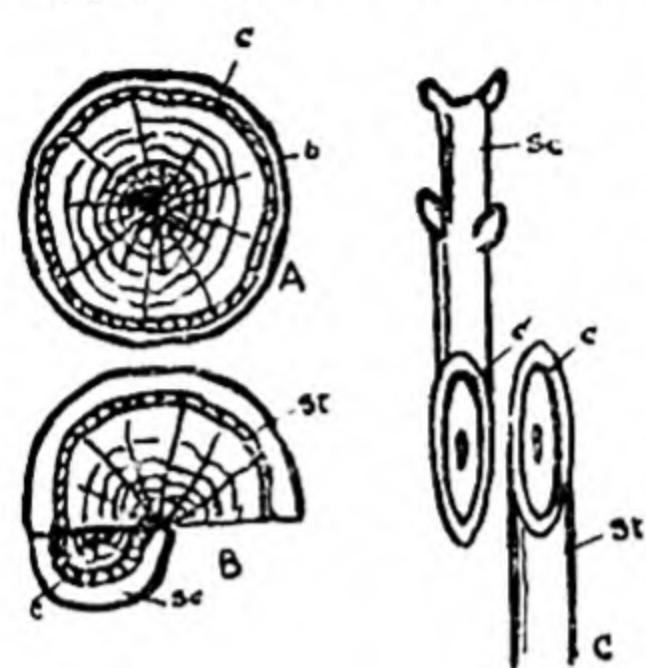


Fig. 48.

Diagrammatic sketch to illustrate principle of grafting.

A = Cross-section of stock (diagrammatic) showing c, the cambium layer.

B = Shows union of cambium of stock and scion into one continuous growth.

C = To show how the stock and scion are cut to fit into each other, the cambium layers of both being placed one above the other for unification.

wounds. (7) Many kinds of plants which are difficult to propagate in any other manner are grafted on allied scions, as for instance, *Franciscea uniflora* is grafted on stocks of *Brunsfelsia americana* and the ornamental variegated form of *Mimusops Elengi* on stock of the ordinary variety.

Physiology of grafting and budding : To attain anything like success in grafting and budding operations, it is necessary that one should have a conception of the structure of the stem and a knowledge of the physiology of those operations. It has been mentioned in Chapter II that in grafting and budding, the object is to bring the cambium surfaces of the stock and scion in contact with each other so that they might unite by the activity of the cells of the cambium. Unless the cambium layers meet fairly well, the

cells of the scion will not be able to get from the cells of the stock, the moisture which is essential for enabling the scion to pass down from its growing buds the material for forming callus and for securing the complete union of the stock and scion. Perfect union only takes place after the scion has made some progress in growth and leaves, which enable it to manufacture enough plastic material to heal the wounds completely and to provide uninterrupted communication between the cells of the stock and scion.

Choice of stock and scion : There are some points which should be remembered in selecting stocks, in addition to those which have been mentioned above. The stock and the scion should be related, as varieties of the same species or as species

of the same genus. For instance, a Sapota cannot be grafted on a Mango stock. Greater the affinity between the stock and the scion, better is the union. Again, the natural vigour of the stock and the scion should be the same as far as possible. It may sometimes be preferable to have the stock in a state of vegetation slightly in advance of the scion, as otherwise the flow of sap is insufficient to supply the wants of the scion. Shoots selected as scions should be firm and well ripened. Watery shoots are valueless. The scion should be selected from branches and branchlets of trees or shrubs which are noted for their superior flowers or fruits, as also the freedom with which these are borne. Similarly, in any one tree or shrub itself, same considerations should prevail in selecting the scion.

Grafting clay : Grafting clay is made by mixing two parts of clay or fine soil with one part of cow-dung and kneading it with a little water.

Grafting wax : It is prepared in the following manner :— Powder 6 lbs. resin. Cut up 2 lbs. beeswax. Place these together in a suitable iron pot. Pour one pint of linseed oil over the mixture and heat over a slow fire or preferably over a waterbath to prevent catching fire. Allow to melt, stir well and pour into cold or tepid water. Knead the stuff in water greasing the hand with linseed oil. Take out and preserve in a jar.

Grafting-wax solution : Heat equal parts of resin and beeswax over a water bath and allow to cool sufficiently till it can be touched with the fingers. Add a pint of alcohol to every 2 lbs. of this mixture, mix well and transfer to a tightly corked bottle. Apply the material with a brush.

Wax-cloth : Wax-cloth used for binding the parts in budding or grafting is made as follows :—Tear thin muslin into strips of $\frac{1}{4}$ to $\frac{1}{2}$ inch breadth and roll them tightly, not more than two inches thick, on wooden sticks. Drop these into a mixture of 4 parts by weight of beeswax and one part of resin and some small quantity, a tablespoonful or two, of fine raw gum, kept melting over a slow fire. Let the sticks remain in the melting liquid for about ten minutes, till the wax has penetrated to the interior. Then, take them out and dry. If the wax is too hot, it will burn the cloth. Unwind the strips of waxed cloth from the roll before use.

Grafting, when and how done : Grafting operations should be carried out as quickly as possible, in shade, in growing weather. The parts operated upon should be protected from sun and air to prevent drying until union is complete. For this purpose, they are covered over with grafting clay or better still with grafting-wax.

Methods of grafting : There are several methods of grafting devised by gardening ingenuity, some one method being more serviceable than the other, in particular cases and circumstances ; but, the principle involved in all methods is the same, namely, the bringing together of the cambiums of the stock and scion for union. The following are a few of the more important methods :—

(1) *Grafting by approach* or *enarching* is the simplest kind of grafting, which is largely practised in India. This method is chosen when the trees or shrubs bearing the stocks and scions are so near each other that their branches may be bent and united. Graft Mangoes, Sapotas and Guavas are, for instance, made this way. Seedlings of the thickness of a lead pencil, either grown in pots themselves or lifted into pots and established therein are raised to the branches of the tree containing the scion and fastened firmly or put safely there on some scaffolding erected for the purpose.



Fig. 49. (a)

Grafting by enarching. The stock and the scion are cut at c c after union to get the graft plant B.

Both the stock and scion are on their own roots in this method of grafting. Both of them are kept nicely growing by supplying them regularly with water. Figure 49 illustrates grafting by approach. A scion of the same thickness as the stock is bent towards it and made supple. On the side of the

stem of the stock where the stems touch, with a sharp knife, a slice of bark one to three inches in length, is taken with a

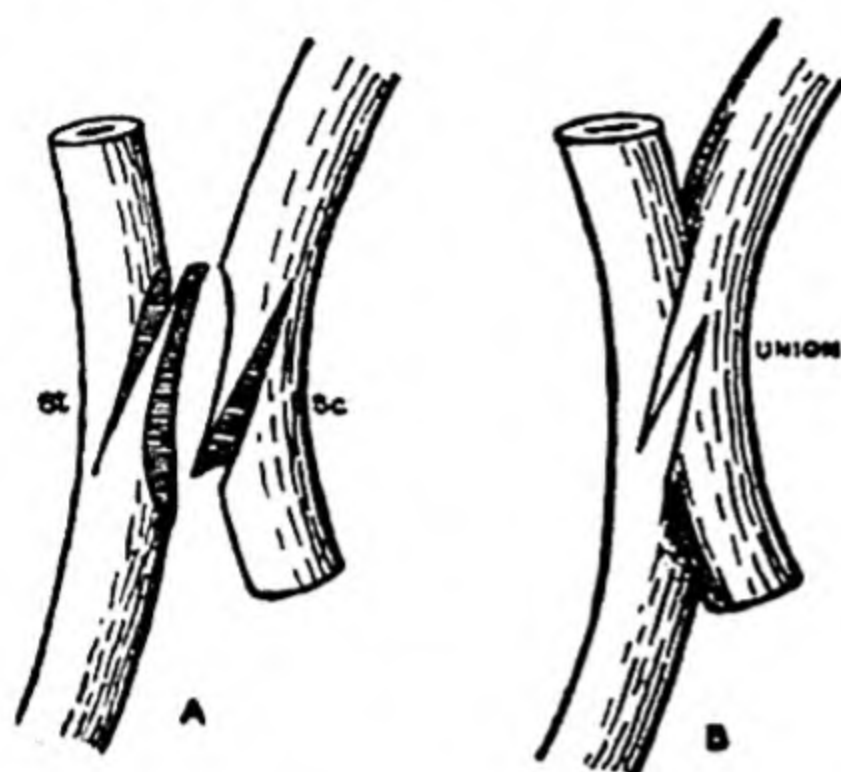


Fig. 49. (b)
Grafting by enarching.

tongue each is cut in the fitted together, as shown in Fig. 49 (b). There would be better and quicker union, as there would be three surfaces for contact and not two only. This modified method is generally employed by skilled and experienced operators. For the stock and scion to unit, it takes 4 weeks to 4 months or more, according to the kind of plant and the age of the stock and the scion. The stem of the scion is notched under the part operated upon every fifteen days after union has decidedly taken place. The notch is

deepened more and more as the scion and stock unite. When complete union has taken place as could be observed by the

thin layer of wood attached to it. A similar piece is taken off the scion, where it meets the stock, and the two cut surfaces are brought together face to face so that their cambium layers are in contact with each other, and then bandaged together firmly with grafting tape or raffia and covered over with grafting clay or wax.

In grafting by enarching, instead of simply bringing together two cut surfaces, a

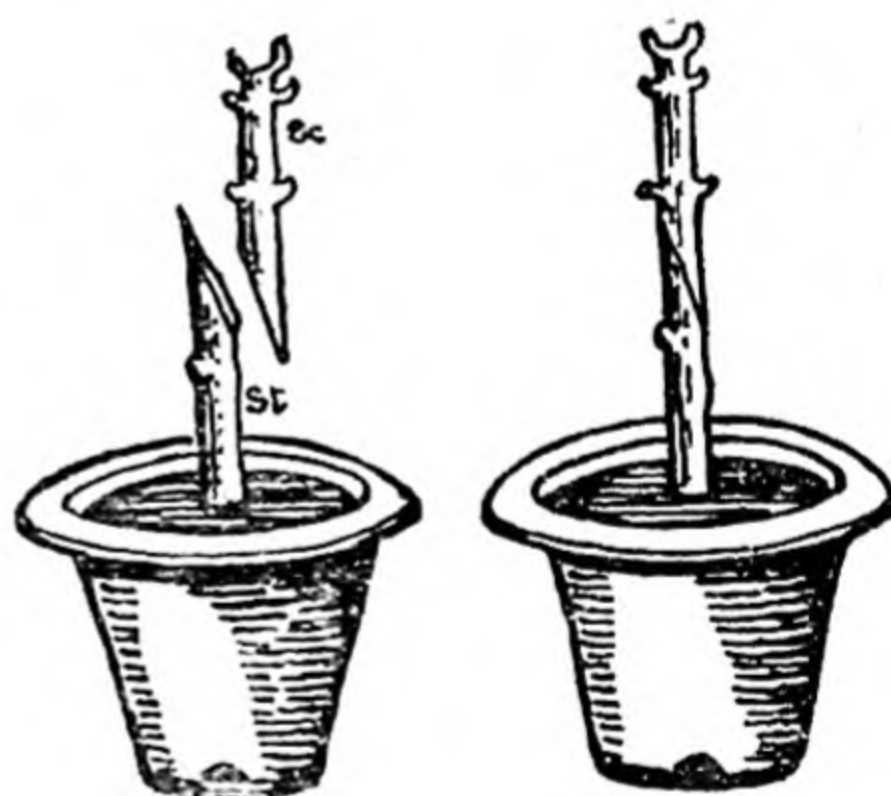


Fig. 50.

Whip grafting (simple).

Sc = Scion.

St = Stock

place as could be observed by the

ties and grafting cloth breaking by the thickening in growth in the region of union and scion not showing any signs of withering after notching it, the scion is severed from the parent plant by cutting it through at the notch. The head of the stock above the point of union is also cut off clean as shown by B in Fig. 49 (a).

The period between February and June is recommended for grafting in South India as it is the growing period for most trees and is free from adverse effects of rain and wind.

The other methods of grafting employed in cool climates in which the scions are not on their roots and are separated from the parent plants, as in whip grafting, are not suited for our conditions except at medium to high elevations.

(2) *Whip or tongue grafting* is most generally practised as the scion much sooner covers the stock in this method than



Fig. 51.

Whip grafting where stock and scion are of different thicknesses.
 A = Stock. B = Scion.

in others. Whip-grafting is especially suited for small stocks or branches of an inch or less in diameter. It is necessary that the thickness of the stock and the scion is the same. At the desired height the head of the stock is cut off in a sloping manner ending above a node. The cut may be conveniently two to four inches long. A corresponding slice is taken off the scion. The stock and scion are then fitted together and tied, bringing together the inner bark of the scion and the inner

bark of stock. The union is more sure in 'tongue grafting'. For this, a notch is made about the middle of the sloping cut, downwards about half an inch deep. The part of the scion

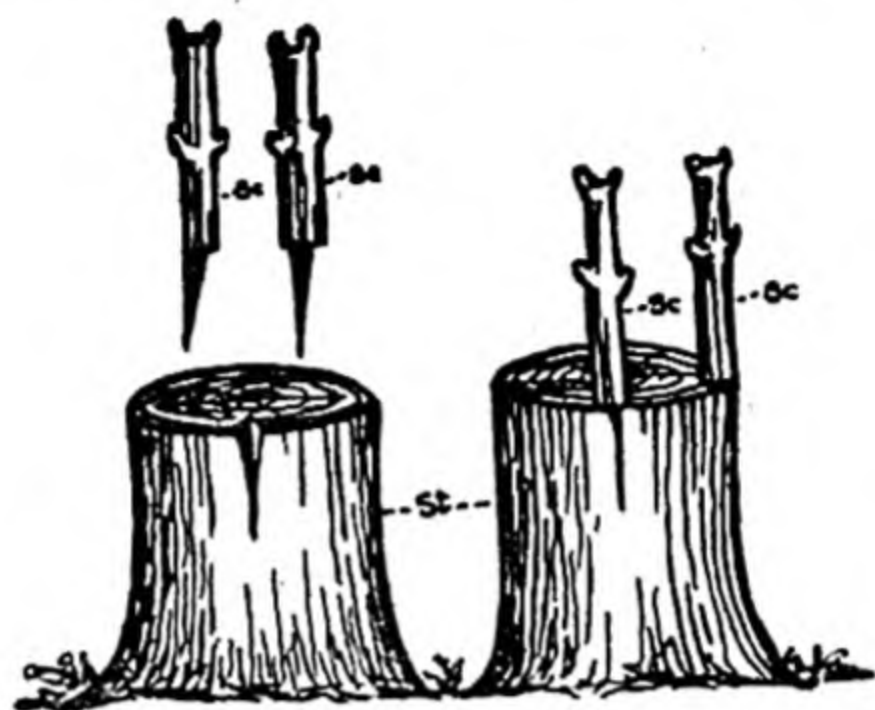


Fig. 52.

Slit grafting.

St = Stock.

Sc = Scion.

which is of the same dimensions is cut similarly in shape in a slanting direction and a slit or tongue is made in this slanting cut in the middle to fit into the notch in the stock. After the scion is fitted on to the stock, the parts are bandaged together tightly and covered with grafting wax.

(3) *Saddle grafting* is a neat and efficient method adopted when the stock and scion are about the same thickness. The

Fig. 52 A.
Saddle Grafting.

stock is cut slopingwise at the top on either side to form a wedge. The scion is split in the middle and each side is thinned on the inside for the wedge of the stock to fit in. The parts are firmly tied together and covered with grafting clay or wax.

(4) *Cleft or slit grafting* (Fig. 52) is done when the stock is two or more times as thick as the scion. The stock is cut straight across to within 8 inches of the soil, making a perfectly level surface. A slit or cleft, 2 to 3 inches long, is made in it with a fine toothed saw or strong knife or chisel. The slit is kept open with a wooden wedge rammed into it till the scion is



Plate 2: COUROUPITA GUIANENSIS

prepared. The scion, 6 to 9 inches long, with a bud at its top is selected, cut into a wedge shape by slicing off opposite sides, pushed into the cleft in the stock, and fixed so that its inner bark meets that of the stock. The parts are then wrapped over with wax-cloth, bound strongly with strong wax tape or fibre and painted over with wax-solution.

(5) *Crown grafting* is done in the case of old trees for renovation. For this, the stock is headed down as in cleft

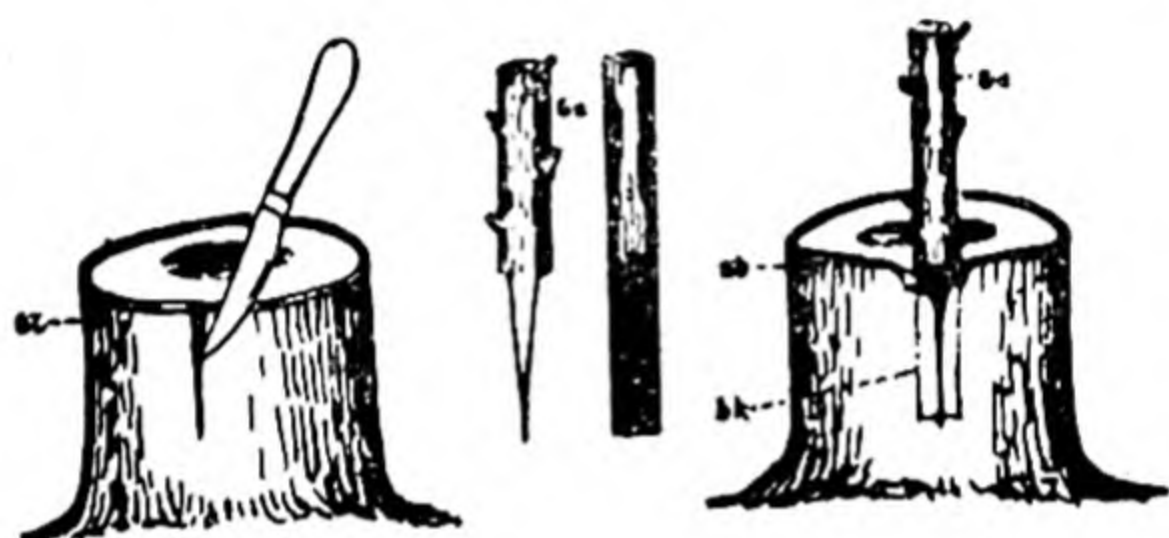


Fig. 52 B.
Crown Grafting.

grafting. A slit, 6 inches long, is then made in the bark from the cut surface downward by passing the knife through the bark without injuring the wood beneath it. Then, the bark is raised from the wood on both sides of the slit by pushing a thin wedge between the bark and the wood at the slit. The scion is about 6 inches long. Its leaves are removed. Its lower end is trimmed on either side as shown in figure 52 B. and then inserted behind the slit. The hole of the cut surface and the trunk of the stock are tied tightly with sacking and thread and covered over with grafting clay. Two or more scions may be inserted on a stock to make provision against failures. Crown grafting is done only at the commencement of the growing season, when only, the wood and the bark can be separated easily in the stock.

(6) *Root grafting* is illustrated in figure 53. Root cuttings of Apples may be grafted with select scions as seen in the figure and inserted in soil for rooting.

(7) In ornamental gardening, *herbaceous grafting* is resorted to for perpetuating certain soft-wooded plants. The

stock is horizontally cut just above a node or a leaf-base, at the place selected, which is not purely of a herbaceous nature but is becoming woody in texture. The leaves just under the node are left intact but others occupying the region to be operated upon are removed. A slit is made in the centre of the stock to a depth of an inch or two and part of the wood



Fig. 53.

Root Grafting.

St = Stock. Sc = Scion.

The ties are removed after union in the graft plant G.



Fig. 54.

Herbaceous Grafting.

A = Stock prepared to receive scion.

B = Prepared scion.

C = Stock with scion inserted in it.

on either side of the slit may be sliced away to make a shaped cleft. The scion is shaped after the manner of a wedge so as to fit into the cleft in the stock, it is then inserted into the stock, and secured in position with coarse worsted or grafting tape, commencing the tying at the top and winding the turns down to the lower parts. The part operated upon is provided with a paper shield to protect it from the drying action of sun and air. A piece of moist cotton-wool may be placed round the part to keep it from drying up.

Care to be taken after grafting : The stock will push forth tender suckers and shoots from under the part operated upon due to the check in its top growth and these should be clean cut away. The grafts should be suitably staked to prevent breaking in the wind. As the union takes place between the stock and scion, the parts thicken and burst the cloth and ligatures round them of their own accord. If the latter are too strong to give way, they are cut away. Shoots from the graft are supported lest they should be blown away. If too long, they are often pinched back to prevent this.

PROPAGATION BY BUDDING

What is budding : Budding is a form of grafting and it consists in inserting a mature bud with a piece of bark attached to it, taken from the plant which is desired to be propagated, underneath the bark of the stock plant in such a way that the nascent tissues of the stock and the scion (the bud) are brought into contact with each other and binding the part operated upon. In course of time, by the activity of the cells, new wood is formed which unites the stock with the bud. As the bud gets more and more united with the stock, it gets from it more and more nourishment and develops into a shoot carrying flowers and fruits. Budding is done on stocks of small diameter, about the thickness of a pencil, at a time when the bark separates easily from the wood. The bud employed as scion should be mature but not too far advanced in growth.

Budding is an operation which is easily learnt by amateurs, requiring some amount of care, deftness of hand and practice for success. With enough number of stocks at one's disposal and obliging friends to supply buds from desired plants, budding is a cheap and expeditious method of making a collection of Roses. And, budded plants being neater are more desirable than grafts.

Conditions for successful budding : Shield or T-budding is the method most generally employed. The following points have to be borne in mind to ensure success in budding :—

- (1) The stock selected should be hardy and suited to the conditions of particular soil and climate.
- (2) There should be close affinity between the stock and scion as varieties of the same species or as species of the same genus.
- (3) The sap should be in active circulation in the stock so that the bark separates readily from the wood.
- (4) The bud chosen should be neither too young and undeveloped nor too old and overgrown. It should be selected from neither at the base nor too much at the top of the shoot.
- (5) The operation should be performed in as short a time as possible, as nascent tissues are vitiated by exposure to air. The bud should never be allowed to dry up by being exposed to sun and it should be removed from the parent plant and prepared just before the operation.

If removed earlier, it should be preserved from wilting by keeping in clean water. (6) The bud should be inserted without any tear or injury to the tissues. This involves the careful removal of the wood that is attached to the bark containing the bud and the clean separation of the bark of the stock from the wood for the insertion of the bud. A budding knife, which is furnished with a flat handle, is very serviceable for lifting the bark without injury to the tissues. (7) Budding can be performed during any part of the year but the time for most successful results is August and September. Strong sun and rain are injurious. Best results are obtained if the operation is done in dull cloudy weather and in the cooler parts of the day.

Budding — how done : *Shield or T-budding* is done as follows :—It is advisable to bud as low down on the stock as possible, unless one wants to make standards of some height. All side shoots on the stock are rubbed off up to the point selected for budding. All suckers from the base of the stem are also removed, as these side-shoots and suckers take a good deal of nourishment for their growth without leaving enough of it to the stock for supplying the growing bud, after budding. See Figure 55(1). A horizontal cut is made across the rind and quite down to the wood, as at 'a' in the figure D, on the stock about half an inch above a bud 'x'. From the middle of this incision, a longitudinal slit 'ab' about an inch long, is made so that a cut, shaped like the capital letter T, is formed by drawing the edge of the knife downwards in a line through the bud 'x'. Care is taken to cut through only the bark without injuring the wood beneath. The bud at 'x' is shaved down to the level of the bark; the bark on either side of the slit 'ab' is gently raised with the flat handle of the budding knife, without tearing or injuring it in any way. Now, the stock is ready to take the bud. A suitable bud is chosen from a young shoot of the current year. With a clean sloping cut cc made by inserting the knife about half an inch below the bud and passing it upwards and inwards till under the bud and then outwards in such a way that a piece in the form of an escutcheon or shield with the bud in its middle is detached from the shoot. The piece contains a slip of bark with a wood

bud on it and a small piece of wood behind it. The part of the wood which is attached to the bud is then carefully removed. For this purpose, the point of the knife is slipped between the wood and the bark at the upper end of the piece, the wood is raised a little so that it could be gripped between the knife and the finger, and then pulled away from the bark with a jerk. In removing the wood from the bud, it is important that the core of the bud or the eye is left in and not withdrawn from the bark. In other words, the small bulge which

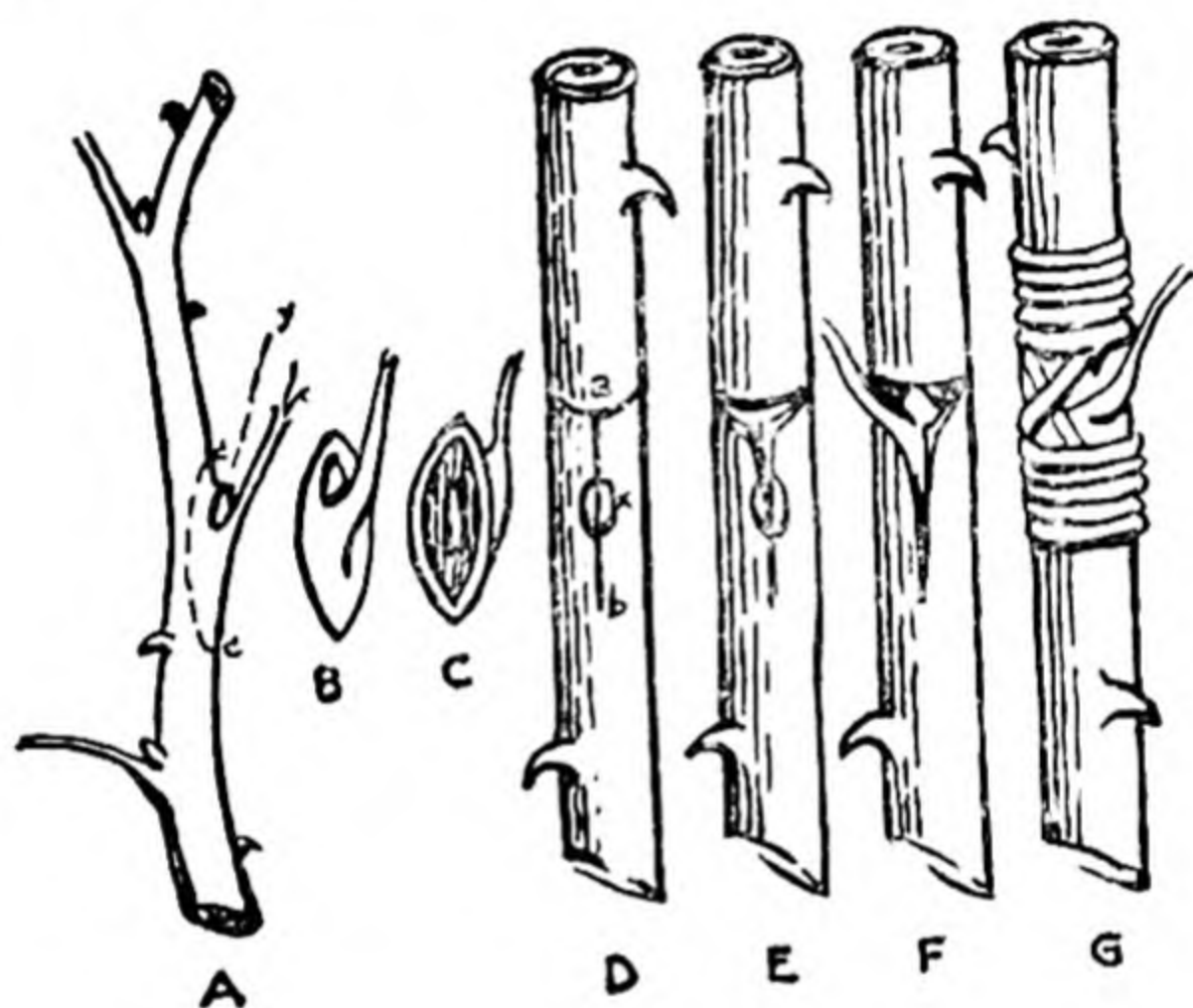


Fig. 55 (1).
Shield Budding.

- A = A healthy shoot with the scion, bud 'y'.
 B = Shield obtained by cutting through A at 'cc'.
 C = Shows underside of the shield with the core of the bud.
 D = Slit, T-like, made in the stock.
 E = Slit, with the bark opened on either side for insertion of bud.
 F = Slit, with the bud inserted in it.
 G = Bud tied to the stock with folds of plantain fibre.

forms the base of the bud is neither to be injured nor removed from it. Thus a shield-shaped piece of bark containing a wood-bud with the leaf on the other side is obtained. If the underside of the bark presents a little hollow behind the bud, it is useless and thrown away, and another bud attempted. The blade of the leaf is cut away leaving a portion of the stalk. Holding

the bud with the leaf-stalk, it is introduced into the slit 'ab' from above after opening it out on either side with the handle of the knife; it is then pushed down gently with slight pressure so that it is placed smooth between the rind and the wood of the stock and the bud occupies its natural position at 'x'. Any part of the bark attached to the bud and which is too long for going into the slit 'ab' is cut off. After exactly fitting the bud into the stock and allowing the bark of the stock to return to position over the bark of the shield, the shield and the stock are tied closely round with raffia or strands of plantain fibre, beginning below the slit 'ab' and proceeding to the top of it, leaving the bud with its leaf-stalk uncovered and peeping through the turns of the tie. The knot is tied above the slit. The operation is now finished. It should be done as quickly as possible to prevent the bud from getting dry. The bud is shaded from severe sun by a paper shield or some other device.

Three weeks or a month after the buds are inserted, they are examined to find out if they have 'taken'. Those which are black and shrivelled up are dead.

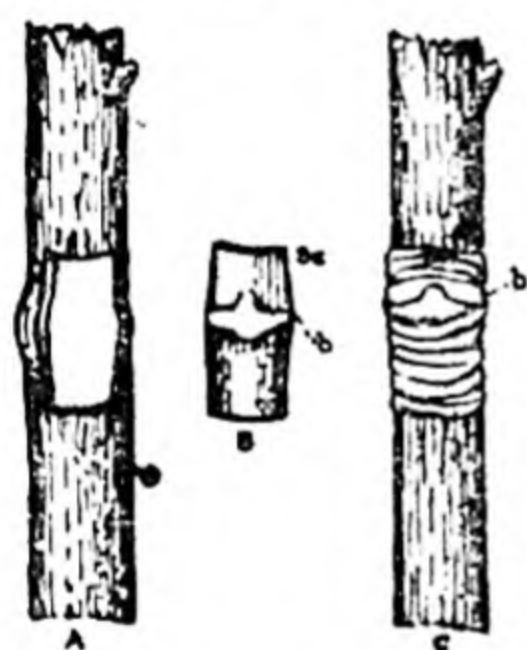


Fig. 55 (2).
Patch Budding.

Those which remain fresh and plump have joined with the stock. If the operation is successful the bud becomes fresh and full, the shield unites with the wood firmly and the leaf-stalk drops off. At this stage, the bandage is loosened so that it may not clench the stock and injure or destroy the bud.

After a month more, the bandage may be removed altogether. All shoots which push out from below the bud

are to be rubbed off. When the bud has developed into a shoot, the stock is cut off about three inches above the bud and the cut surface is smeared with white lead or a thin splash of tar. The short length of stock thus left above may be useful to fasten the new shoot developed out of the bud and thus prevent it from getting blown off by wind. After a few more months, the stock is further 'headed back' close to the bud. When this is done the whole effort of the stock is directed to the inserted bud. Thenceforward also, side shoots

and suckers, if any, from the stock, are removed constantly.

In patch budding, a rectangular patch of bark is removed from the stock and a similar patch removed from the plant to be propagated is fixed exactly into the depression and tied firmly round with raffia or plantain fibre, after smearing a small quantity of grafting wax over the parts.

MAKING NEW VARIETIES

It is the ambition of every garden enthusiast to raise something new which will be welcomed by his fraternity as an acquisition. New varieties can be easily raised by an observant amateur in one of two ways:—(1) from seeds, obtained by cross-fertilisation and hybridization of flowers of two different species, or two varieties of the same species, or of two species belonging to the same genus, and (2) by vegetative propagation of 'sports', and fixing them, as mentioned below.

The transference of pollen from one flower to another is very simple and it forms the essence of plant breeding. In many flowers, the male and female parts, the stamens and the stigma respectively, are easily distinguishable; in others, they are identified easily with a magnifying glass and a knowledge of botany.

The first necessity in cross-breeding is to emasculate the flower and this is effected by removing the anthers holding the pollen grains of the flower, which is to be the seed-parent. The second necessity is to protect the stigma from possibility of chance fertilization by the agency of wind, insects, etc., by enclosing the emasculated blooms in thin muslin bags.

At the correct moment, when the surface of the stigma is most receptive with the sticky honey on it, (this differs in different kinds of flowers), the pollen from the selected flower is transferred to it; a small camel hair brush will be found serviceable for this purpose. The flower which has been thus cross-fertilized, is bagged till the stigma withers and cannot receive any pollen. The bag is then removed, the seed pod gradually develops and ripens, when the seeds are collected.

There are however some limitations to the possibility of

effecting crosses. There must be close affinity between the two flowers selected as varieties of the same species or as two species of the same genus. For instance, it is not possible to cross a Carnation with a Corn Flower. In some rare cases, bigeneric hybrids have been raised, as *Lælia Cattleyas* (orchids). Though chance fertilization has resulted in adding to the list of novelties, the hybridizer should try and work up his creation to his aim, which should be to get a new thing, which would be an improvement upon the parent plants. At the same time, it is necessary to mention that it is impossible to forecast with certainty what would be the nature of the cross. It is always shrouded in mystery, and it is this which makes the pursuit so very fascinating.

Sports and sporting : Any departure from the normal in the several parts or entire plants themselves is called *sporting*. All or any part of a plant is liable to change sometimes, the reason for this change being unknown. Sporting may be observed in flowers, leaves, stem or root. Where only red flowers are expected from seeds collected carefully from a red flower, a white flowered plant may come up as a freak, or in any red flowering plant, a white flower may be produced. If seeds are collected from such white flowers and sown, it is just likely, a number of white flowered plants may be secured, and thus the variety may be fixed by further selection. Bougainvillea Louis Wathen called by some "Orange Glory", is a sport of the scarlet-crimson flowered kind, B. Mrs. Butt. A branch of Mrs. Butt produced fine orange-coloured sprays of bracts and this was perpetuated by vegetative propagation of the shoot. Though the variety has been fixed fairly well, one finds sometimes Louis Wathen 'reverting' to Mrs. Butt or bearing orange-coloured bracts on some branches and scarletred bracts on others. Many new varieties of Roses are but sports of some old varieties. Several new varieties in Crotons have been raised by the author by propagating branches and shoots which bore foliage characteristically different from the normal. A Pentas carnea, with leaves variegated green and white has been likewise produced. A sporting shoot is propagated by cuttings, by layering, or grafting; thus the sport is, if possible, 'fixed'. In other words, its characteristic is perpetuated.

CHAPTER VII

PLANTING AND TRANSPLANTING

Two familiar operations: Planting and transplanting are familiar and essential garden operations. Planting consists in transferring young plants, shrubs and trees from nursery beds or pots to their permanent places in the garden. Transplanting consists in lifting plants bodily from their positions and removing them to more desirable or agreeable places and planting them there in new and better soil. Several kinds of plants are benefitted by one or more shifts, being stimulated to vigorous and healthy growth, by the increase of fibrous roots. In the routine of gardening, transplanting is also resorted to for filling up vacancies or replacing weak and unhealthy plants with fresh and vigorous ones.

How seedlings are transplanted and then planted out: Though the expressions planting and transplanting are familiarly used in connection with trees, shrubs, and larger plants, it may not be out of place here to refer to these operations with regard to seedlings of annuals and other young plants from the nursery. Before finally planting these out in beds or potting them, they are gradually inured to open air conditions, as described in pages 68 and 69. For planting them out, the flower beds or borders, as the case may be, are dug up to a depth of about a foot and a half, the soil is mixed up liberally with well decomposed leaf-mould and manure, at least a fortnight or two before planting. A day or two prior to planting, the clods of earth are broken up, the soil is made fine and smooth, levelled and copiously watered to render it soft and mellow for planting. The positions to be occupied by the young plants are marked out; the plants are set at such distances apart that when fully grown, they would just touch each other. For marking out the places for the young plants, a bed marker may conveniently be used. The young plants are taken out of the seed-beds or seed-pans with as much of soil attached to their roots as possible, without damaging them, and placed in fresh soil in holes made for their reception with a dibber or a trowel. The holes are

then covered and the soil pressed round the stems on the roots. When the planting is finished, there are to be no depressions in the soil round the stems. The bed is then copiously watered. The plants are shaded with green twigs or bamboo thatties held by supports. Till the plants are well established, no more water than is necessary to keep the soil just moist is to be supplied. The young plants may however be lightly sprayed with clear water, both morning and evening with advantage. The supply of water is gradually increased with increasing growth of the plants. The twigs or thatties are removed completely after four or five days by which time the plants may be expected to establish themselves.

Season for planting and transplanting shrubs or trees : The best season for planting or transplanting shrubs and trees varies in different parts of this country. Hot weather is avoided generally as the risk of plants not establishing is great. Where rainfall is moderate, the beginning of the rainy season is best suited for the purpose. Plants which are natives of cold countries and which grow vigorously in the cold season such as the Rose, do better when planted out during the close of the rainy season. In districts where rainfall is excessive with resulting fear of waterlogging, planting and transplanting operations are best postponed till about the close of the rainy season. In places where there is real winter as in Punjab, the operations are best carried on during the end of the dormant season about the end of February. But, all robust plants may be planted or transplanted during any part of the year, with proper attention being given to several important details of the operations.

Transplanting failures: Transplanting involves to some extent at least a destruction of the plant's root system. There is a loosening of its attachment to the soil and its progressive activities are arrested for the time being. Thus transplanting is rather a violent operation, considered from the standpoint of the plant and hence requires to be done with very great care to be successful. Care is therefore to be taken that the plants recover from this set-back as rapidly as possible. Certain conditions are necessary for the rapid recovery of plants to active growth. Some of these are dependent upon the nature

and structure of the plants themselves and some on the prevailing weather and climatic conditions. Soft-wooded plants transplant better than hard-wooded plants; plants in dormant



Fig. 56—I.

- A = Shows too shallow planting.
 B = Shows correct planting.
 C = Shows too deep planting.

state transplant better than those in active growth; and young plants establish sooner than old ones. All plants transplant



Fig. 56—II.

To show how roots are to be spread out as in B, while planting.

better with a mass of soil about their roots, which are disturbed as little as possible. As the roots, till they establish themselves in fresh soil, will be unfit to absorb the full supply of moisture needed by the plant, exhalation from the leaves and shoots of the plant is to be kept as low

as possible. Cool and moist or cloudy weather is chosen for transplanting operations. Evenings are better suited than mornings or afternoons, as plants refresh themselves during the cool hours of the night. To overcome the dangers of transplanting the soil is well prepared and kept moist, not allowing it to run dry; part of the top of the plant is removed usually to minimise loss of water by transpiration; some shade is provided till the plant establishes itself well. Overhead watering by means of a syringe, during the hot hours or occasionally when the leaves wilt, refreshes the plant to a great extent. The stem and branches of trees transplanted are wrapped with straw which is kept moist by syringing water on it to remove loss

of water by the plant as much as possible.

Planting of trees and shrubs : After marking out the positions for planting, holes are made at least a foot and a half wider and deeper than the roots will occupy when they are spread out. It is best, how-

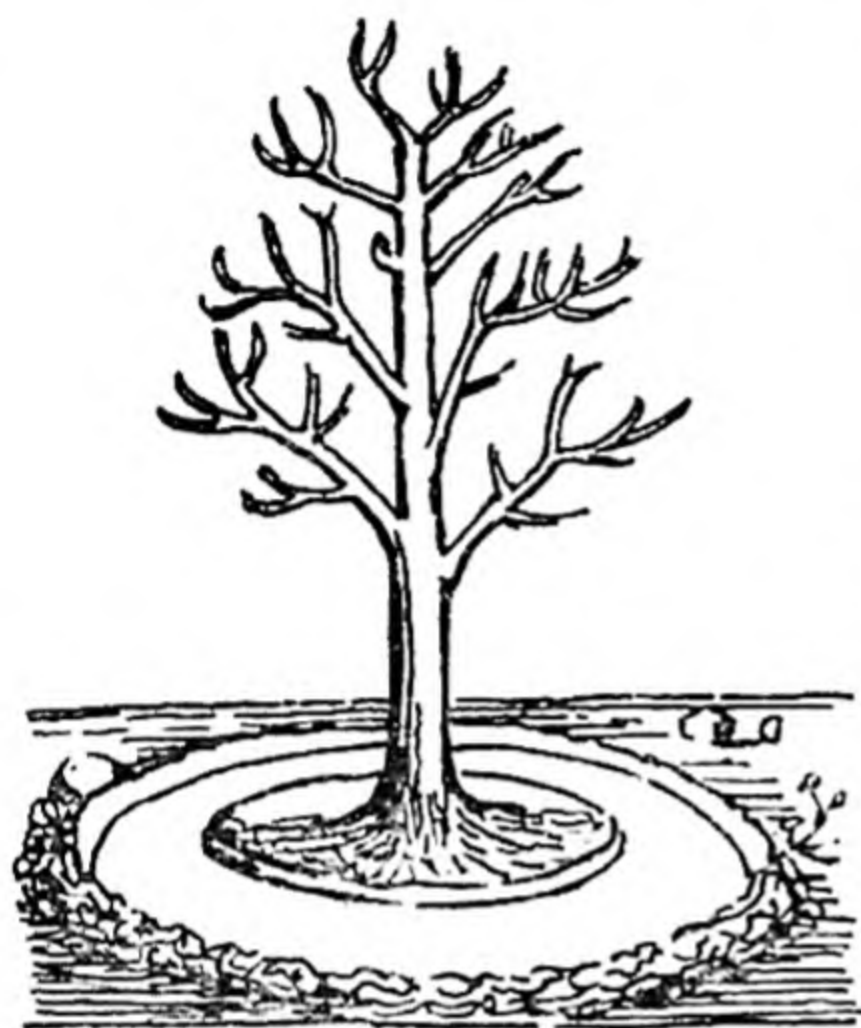


Fig. 57.

A tree planted and a basin prepared for watering.

ever, to prepare, a couple of months before planting, pits about three feet cube, spacing them in such a way that the adjacent trees when fully grown do not touch each other but have some space between them so that all of them get uninterrupted air and light. In making the pits, the surface layer of soil, which is generally good, is kept on one side unmixed with the rest of the soil. If the soil is bad below, it is replaced with a mixture of about three parts of manure, two parts of red earth, and one part of sand. If the soil

is fairly good, it is mixed with manure ; sand is added to the soil if it is heavy and the hole filled, using the top soil for filling the upper portion of the pit. The bottom of the hole is forked for drainage. This is further assured if a 4—6 inch layer of broken bricks and stones is spread on the bottom of the hole and this is covered over with dried leaves or straw to prevent clogging. In places infested with white ants, it is advisable not to have much manure in the soil, especially round the plant. The soil is watered through and gently pressed down, a day previous to planting, so that it may not further settle down after planting. While planting, a small hole is made in the centre of the pit slightly larger than the ball of earth holding the roots of the plant. A layer of sand is put into this hole on which the ball of earth is placed, the plant occupying the centre of the hole. Before putting the plant

into the hole, all its damaged roots are cut back clean beyond all breaks and serious bruises. If the plant is tall and is likely to suffer swaying by the wind, it is supported by a sturdy stake to which it is tied. The stake is put into the hole by the side of the stem of the plant. The roots are spread out in the hole in their natural positions and covered with sand. The hole is then filled up with fine soil, working the fine soil and sand between the roots. The soil is pressed down firmly by treading it down, leaving a shallow depression all round for watering. Care is taken that the plant is not buried deeper than in the nursery. A small ridge may be formed round the stem, about two feet in diameter for watering. The soil is soaked through with water. In the absence of rain, the plant is watered once in three days liberally. The new plant is protected from severe sun, especially during summer, with cocoanut leaves or thatches or by planting some green branches of the Milk Bush (*Synadenium Grantii*) or Milk Hedge (*Euphorbia tirucalli*) which also serve as guards, till the plants are well established.

Transplanting of trees and shrubs : Transplanting of fully grown trees can only be successfully done with the help of machinery, such as the tree lifter, and hence it is rarely attempted in private gardens. Transplanting of young trees and shrubs, however, is done in the following manner :—The plants have to be lifted with as many roots as possible and replaced in fresh soil with the least possible delay. For this purpose, a trench, 18 to 24 inches in width, which is wide enough for working conveniently, is opened out in a circle at a suitable distance away from the stem, which may vary from 1 to 4 feet according to the size of the tree or shrub ; the soil is gradually removed in the trench approaching the centre of the circle as it descends, thus securing the ball of earth in the shape of an inverted cone ; care is taken not to injure the roots that cross the trench ; these are clean sawed or cut with secateurs, if small enough, at the outer edge of the trench. The tap root is also severed. With long crow-bars, the ball of earth holding the roots is gently lifted and loosened from its attachment with the rest of the soil. When the trench is sufficiently deep, the diameter of the ball of

earth may be reduced to a convenient size with a fork, leaving the protruding roots uninjured. The tree is then bodily lifted taking care not to break the ball of earth and not to bruise the bark of the stem in the operation. If the ball of earth happens to be too large, to prevent the earth from slipping away, it is tied strongly with sacking or straw. All the roots with jagged cuts or bruises on them are clean cut back to healthy parts, as bruises and bad cuts may bring on decay which may spread to the plant, killing it. If by chance, the earth breaks away from the roots, these are immediately smeared well with a thin paste made up of $\frac{2}{3}$ clay and $\frac{1}{3}$ fresh cow dung and water. The entire plant is then lowered into the hole prepared for it, which is wide enough to take in all the roots when spread out. Sand or fine soil is worked in between the roots and the hole filled with good soil which is pressed down layer by layer. Replanting is done to the same original depth, if not one or two inches deeper. It is not safe to place any fresh manure in contact with the roots. If one is diffident of success, the transplanting may be made safer thus :—The ball of earth may be got ready in three stages. The roots may be severed on one-third of the circle in the trench and this portion closed down lightly with soil. After a week or fortnight, the roots in the next third of the circle are severed and this part of the trench also lightly closed. After another week or fortnight, the roots in the last third of the circle are severed. The ball of earth has now roots sufficiently recovered from the shock of cuts and can be safely lifted and transplanted.

All broken limbs are removed. The leaf surface of the tree is reduced to limit transpiration ; and the tree is cut back, if necessary, to concentrate the sap at the roots for formation of new roots to establish the tree. "Heading in" or cutting the top of the tree is most desirable in many species. If the tree has several strong long branches, each one of them may be reduced to one-third its length. If the tree has one long branch with several smaller branches starting from this leader, each of the smaller branches may be cut back to half a dozen or more buds, according to the tree ; if there are only a few of such branches, they may be reduced by two-thirds of their

length. The cut surfaces are all covered with white lead or a thin splash of coal-tar, or with paste of cow-dung and red earth in tar water, to prevent fungus and insect attacks.

After the tree is planted, it is to be supported by being tied to a stout long stake, firmly fixed to the ground close to the trunk and protected from cattle by a tree guard. If the tree is large, it may be supported by strong ropes or wires fastened to three strong pegs driven into the ground, placed equidistant round the tree; or, three strong stakes may be driven into the ground three feet away from the stem on three sides and these may be connected at the top with the tree by slender or split bamboo. The stem may be advantageously wrapped round with moist straw to limit loss of moisture from the tree. The tree is then copiously watered soon after planting, so that the entire ball of earth and the new soil above and under it are well moistened. After such liberal watering, it may not be necessary to water again for another three days or so. But the tree may be refreshed by spraying on it clear water both morning and evening. It might be provided with shade if the sun is severe.

The ground around the stem is watered freely every week or so, in the absence of rain. Too much water is not however to be applied, forming puddles at the bottom of the hole in which the tree is planted. Throughout summer, the transplanted tree should get its regular water supply, the soil being soaked through at each watering and not merely sprinkled on the surface. As the surface layer of earth is drying up each time after watering, it may be stirred to a depth of one or two inches, forming a dust mulch. This retards loss of moisture from the soil by evaporation and the tree is enabled to get the full benefit of the water supplied.

CHAPTER VIII

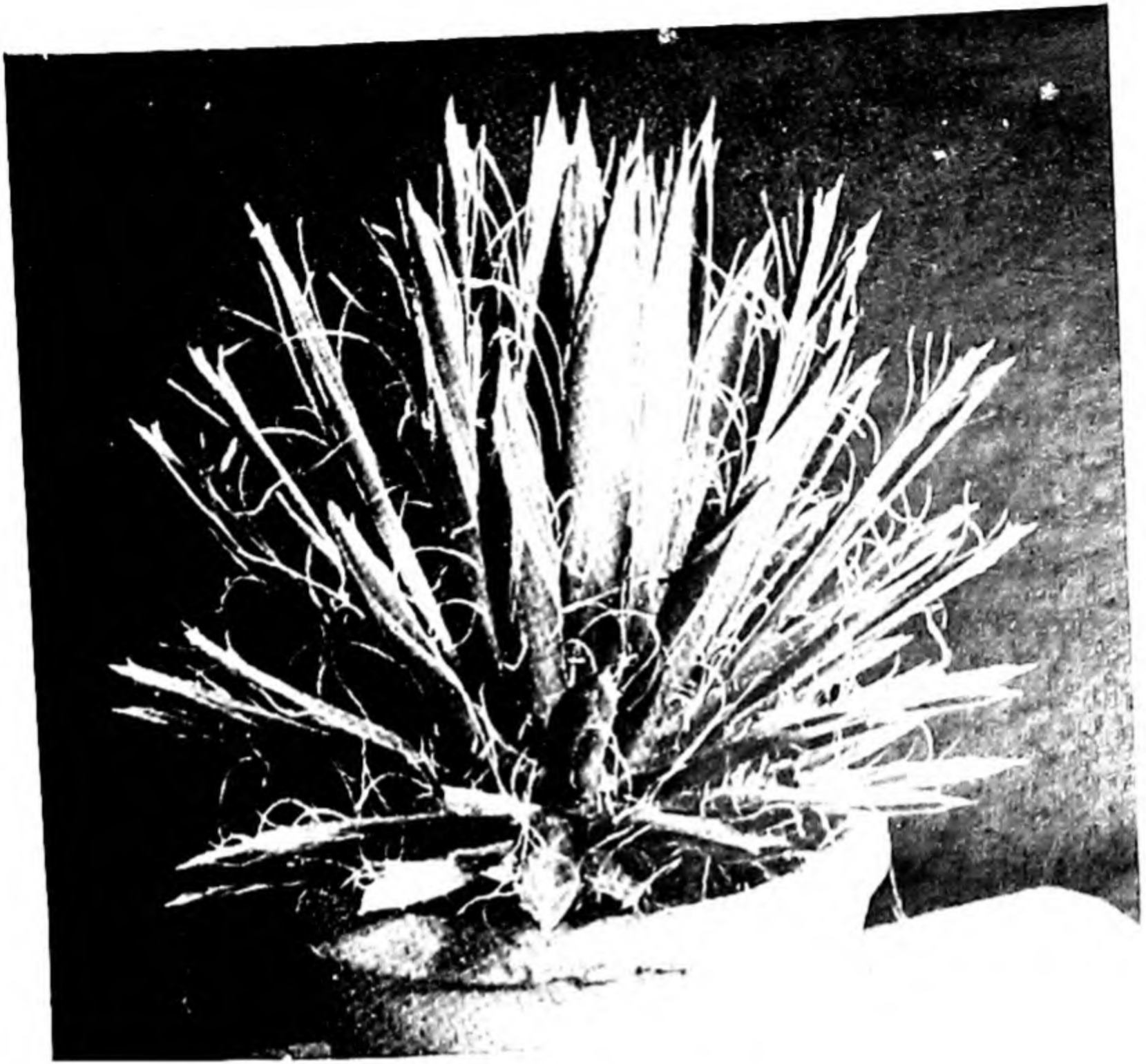
WATER AND WATERING

Supply of water to the garden : To maintain a garden in good condition, an unfailing supply of pure fresh water is necessary. Brackish water, with a large percentage of alkaline salts, is thoroughly unsuited for growing a majority of plants. Such water can be rendered safer for use by addition of requisite quantity of lime.

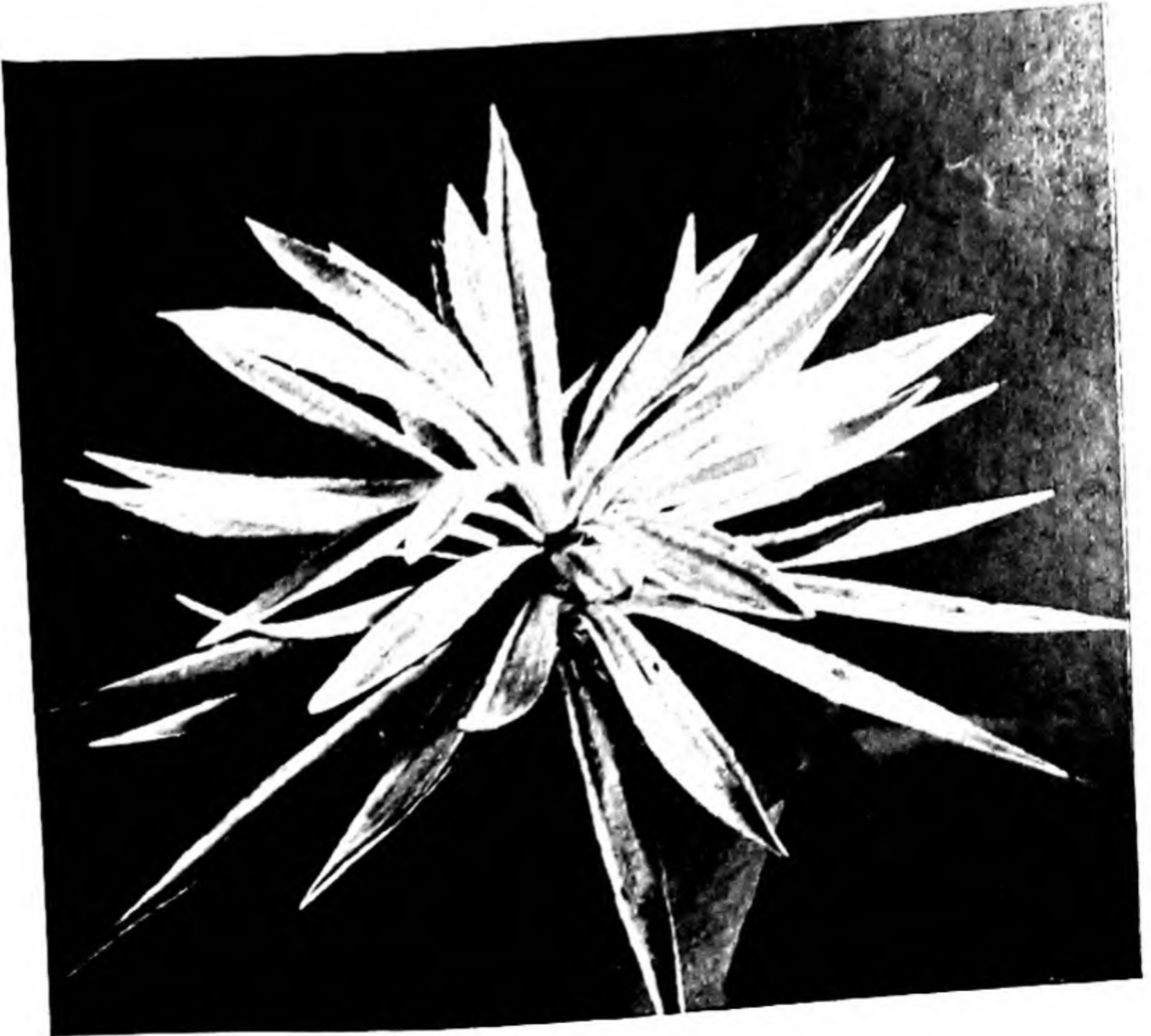
The source of water is very often an open well. The old methods of lifting water by the mote, the pecottah, etc., are superseded by the use of labour and time-saving power pumps, driven by electricity or oil-engines. There are several types of modern appliances for lifting water, suitable for deep or shallow wells, capable of delivering any required quantity of water. They can be handled and worked by any trained person.

A successful tube well would furnish an unfailing supply of water which can be pumped up for use to any part of the garden. Before planning a garden, one should make sure of a constant and plentiful supply of water. An efficient scheme for watering a fairly large garden consists in pumping up water from the well to an overhead tank or reservoir and in conducting the water to the several parts of the garden through a system of distribution pipes. The farthest parts may conveniently be watered by means of hose pipes connected on to the distribution pipes. The overhead tank may also be dispensed with by pumping water direct from the well into the distribution-main and regulating the supply to different parts of the garden by means of glandcocks. Though such a scheme involves some initial outlay, it is cheap in the long-run on account of the saving of labour and trouble in carrying water in pots to the trees, shrubs and plants in different parts of the garden.

In the case of cottage gardens, hydraulic pumps may be fitted up to the wells, replacing the pulley and the rope. There are several makes of these, which are very serviceable,

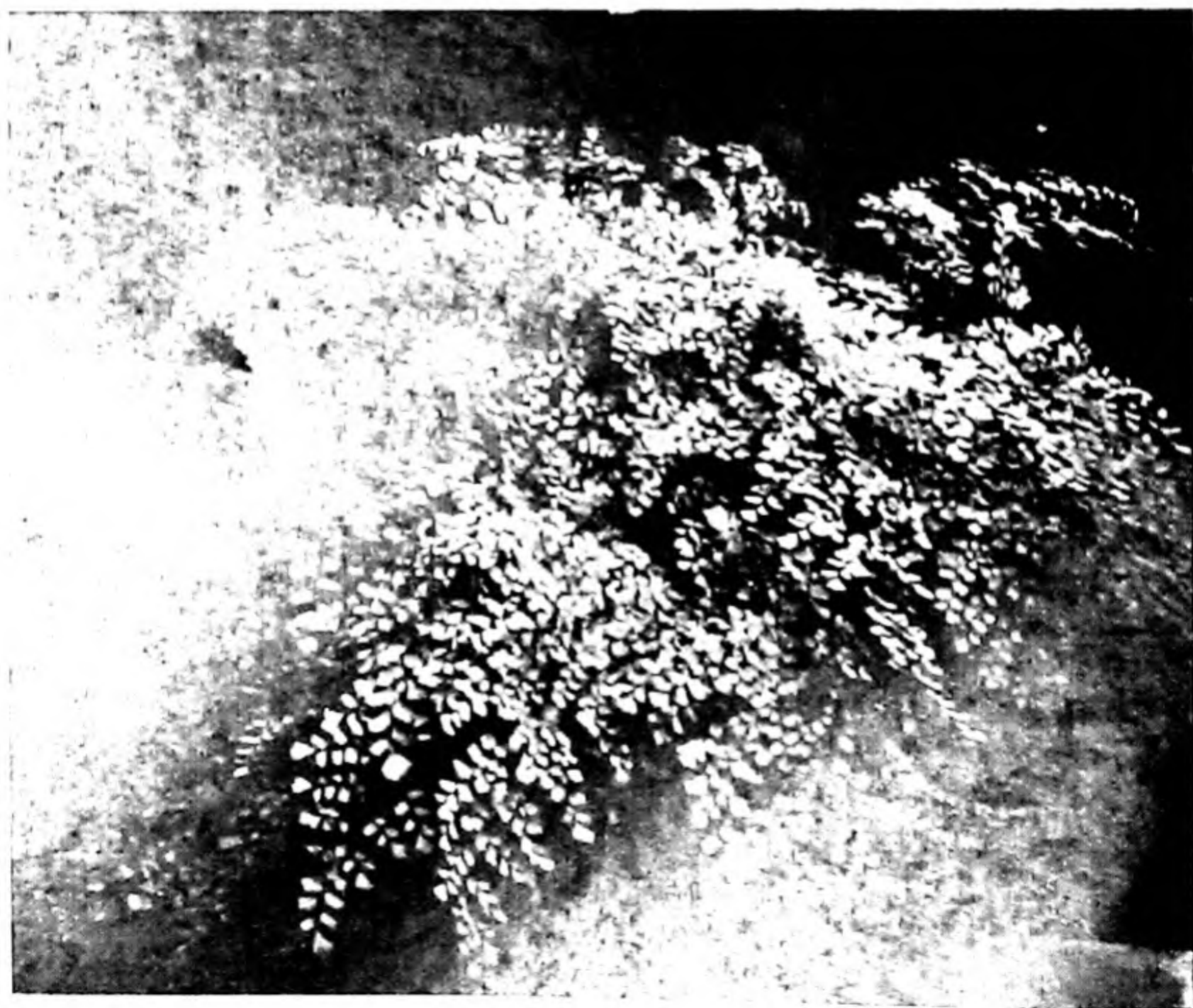


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strong and durable, and easy to work. Automatic pumping sets with $\frac{1}{2}$ H. P. motors are becoming increasingly popular, as they occupy very little space and can be used in connection with narrow wells.

Necessity of water for plants : It has been mentioned in Chapter II, that water is a constituent of plant food and that its value consists essentially in its solvent action, dissolving nutritive salts and thus acting as a carrier of food to the roots of plants.

Watering is an important operation in the cultivation of plants. The health of a plant depends in a great measure on the exercise of judgment and care with which it is supplied with water. Success largely depends upon knowing when and how much of it to apply. Watering is learnt by experience, assisted by some knowledge of the commoner facts of plant physiology and soil physics and chemistry.

Plots of ground are watered either by irrigation through channels from the source or with a hose from a stored supply as mentioned above. Water cans with their spouts fitted with detachable 'roses' are very necessary for watering seed-beds, seed-pans or boxes, pot plants, etc. A coarse 'rose' is used for larger plants while a fine one is used for watering slender ones and small seedlings.

While too little moisture in the soil checks the growth of plants and hastens their premature decay, too much of it soddens the soil, causes the roots to rot, and consequently causes the plants to suffer and die. A safe guide would be not to water a plant till the soil has become dry but not "powdery-dry." This condition is reached when the plant would suffer if watering is further delayed. Watering, whenever undertaken, should be done to soak the soil through and not merely to moisten the surface. Mere sprinkling of water on the surface of the soil is injurious. It merely chills the surface soil, and is soon lost by evaporation; besides it draws the tender roots to the surface to be scorched there by severe rays of the sun. The best plan for watering trees, shrubs, and large plants in beds and borders, would be to stir the surface soil to a depth of 1—2 inches with a fork, to apply water in the evening copiously wetting the soil through and hoeing the soil after a day or two, covering it with a "dust-mulch." To conserve

water, instead of watering over the ground, a pot of the suitable size may be sunk in the ground near the plant and filled with water from time to time to soak into the soil below through the drainhole and keep it moist. In summer, it would be advantageous to further cover the loosened soil with decayed leaves. This mulch would prevent rapid evaporation of moisture from the soil and prolong the interval between any two waterings, and in addition preserve the roots from the scorching rays of the sun. As the feeding root of large plants are not near the stem, they are to be watered two or more feet away from it. It is useless to water them by pouring water into small circular basins made round the stems. Instead of benefitting the plants, the practice will induce stem rot and destroy them.

The quantity of water and the frequency with which it is to be applied depends upon a number of factors, chiefly, the nature of the soil, the nature of the plant, and the extent of evaporation that takes place from the soil. Light soils require comparatively larger quantity of water than heavy soils which are naturally of a greater water-holding capacity. Rapid growing plants are more greedy of water than slow-growing ones. Soft-stemmed plants, especially those with large leaves, need as a rule, more water, than hard-wooded plants. While soft-wooded plants recover soon after application of water when they flag for want of water, hard-wooded plants suffer from permanent injury and possibly die too, from the soil becoming too dry. As a general rule, no plant in active growth should be allowed to droop and suffer checks in growth from deficiency of water. Plants in dormant state need no water or very little of it, while those in active growth should be supplied liberally. The seasons of active growth and rest of particular plants should therefore be watched and watering should be accordingly regulated. Small cuttings, or freshly potted or planted plants are not in a condition to use much water till their roots take hold of the soil and grow. Freshly planted seedlings and young plants do not need to be watered for one or two days after the first copious watering done soon after planting them. As more and more roots are formed and the plants make progressive growths, the dosage of water is increased. Plants with plenty of foliage on them require more

water than those with sparse foliage or those which have their stems pruned back or which have lost their foliage on account of disease or insect or fungus pests. Unhealthy plants are best kept on the dry side till they show signs of renewed vigour. Plants in shade require to be watered at longer intervals than those exposed to sun, as more water is lost by evaporation from the ground in the sun than in shade.

Plants are best watered either in the morning or late in the evening. The hottest parts of the day should be avoided. In the case of plants which need to be watered more than once a day to prevent them from flagging, the times of watering are so adjusted that no watering is done when the sun is hot. Plants in shade are preferably watered in the morning as excessive humidity of the atmosphere round about them during the cool hours of the night may subject them to attacks of mildew.

As plants are sensitive to heat and cold, water of a higher or lower temperature than the soil or the superincumbent air should not be applied. Well water, if it is too chill in the morning, should be allowed to stand over in a reservoir for a few hours. Waste water from bath rooms should be cooled down to atmospheric temperature before it is applied.

The several points which need emphasis in watering pot plants are mentioned in Chapter IX.

A majority of plants are greatly refreshed by syringing clear water on them. But plants with hairy foliage as those of Gloxinia, Petunia and the like and some such as Maiden Hair Ferns with fine delicate foliage dislike overhead watering. Syringing is of great value. It dislodges the dust from the foliage, enabling the leaves to carry on their functions of assimilation and respiration better; it checks loss by transpiration and thus enables the terminal shoots and young leaves to receive a sufficiency of sap from the stem; it keeps the air cool for the plant and this is greatly relished by several plants as Ferns and palms; and lastly it keeps away many an insect pest. Syringing is never to be done when the sun is hot and is on the plants, as drops of water act as burning glass scalding the foliage.

CHAPTER IX

CULTIVATION OF PLANTS IN POTS

A horticultural necessity : Cultivation of plants in pots is a horticultural necessity. It is one of the effective means of beautifying a garden. Pot plants are easily handled and removed conveniently to desired situations in the garden for purposes of decoration. In times of scarcity of water, a much larger number of plants can be grown in pots than in the ground. Plants such as tuberous-rooted Begonias, Gloxinias, Cinerarias, etc., which are not hardy enough to be grown in open ground are grown in pots in sheltered situations. The same is true also of frail seedlings, which are either pricked into seed-pans or planted in 2 or 3 inch-pots singly, or established and hardened in them before they are planted out or shifted to larger pots.

Demerits of pot culture : Pot culture is, however, not free from difficulties and disadvantages. It is doubtless true that it is opposed to the natural mode of growing plants in the ground. They are forced to grow in circumscribed limits in limited root space and quantity of soil with limited food contents and restricted æration. They are further subjected to extremes of humidity and temperature, especially when placed in exposed situations. They are thus subjected to severe trials of endurance, as a result of which, they weaken and die unless they receive due care and attention. Potting is an interesting operation, which though simple, requires a certain degree of skill and practice to do it in the right way.

Pots : Pots are made of burnt porous clay in various sizes, to provide the requisite amount of soil and root space to different kinds and sizes of plants. They have straight sides and are made wider at the top than at the bottom to hold the greatest bulk of compost where the feeding roots are and to facilitate easy removal of soil, intact with roots (ball of earth) at the time of planting out or repotting. Usually, the vertical height of the pot is the same as the internal diameter at the top. Pot sizes vary from 2 to 18 inches.

Pots with a protruding edge at the top with a bulge or curve in the middle of the sides are to be avoided as they do not allow the ball of earth to be turned out intact. Only well baked pots with uniform thickness throughout, except at the rim where it ought to be double the usual thickness, are to be purchased. Small pots up to six inches should have a hole at the bottom, or at the side at the junction of the bottom with the side; larger pots should have one or two more holes according to size. Small 2-3 inch pots are used for potting singly very small seedlings during the first transplanting. They are shifted to larger pots, as the pots they are in are filled with roots. 6-inch pots are the most favoured for growing well rooted cuttings of several kinds of plants and small plants of all kinds. 9-inch pots are commonly used for growing almost all kinds of annuals. Large 15-18 inch pots are used for growing Dahlias, Cannas, large Crotons, shrubs, Roses, etc.

Pots of special sizes and shapes are used for special purposes. For seed-sowing, what are called seed-pans, which are broader than deep, are preferred. Again for plants like Ferns, which have a shallow root system, pots less deep than the normal are used. For seedlings of trees, as those of the Mango for instance, with long tap roots, long pots are used. Orchids which require plenty of drainage and æration for their roots are best grown in pots perforated all over the sides. Pots used in the cultivation of bog plants, virtually consist of two distinct pots, one inside the other, a narrow space being left between the two for being filled up with water, damp moss, or sand to keep the soil in the inside pot containing the plant always moist.

Provision for drainage : The first essential of good potting is the provision for efficient drainage. The water supplied to the plant should pass out of the pot after wetting the soil through. It should not be allowed to stagnate in the pot round about the roots. The drainage of a pot is effected in a simple way. For pots up to four inch size, a single piece of broken pot, which is known technically as a crock, is put against the drain hole, with its concave or hollow side turned towards the hole. If extra drainage is necessary, a few smaller pieces of crock may be placed next to it. For larger sizes,

a large crock is placed against each of the drain holes and some more pieces of crock are placed above these overlapping

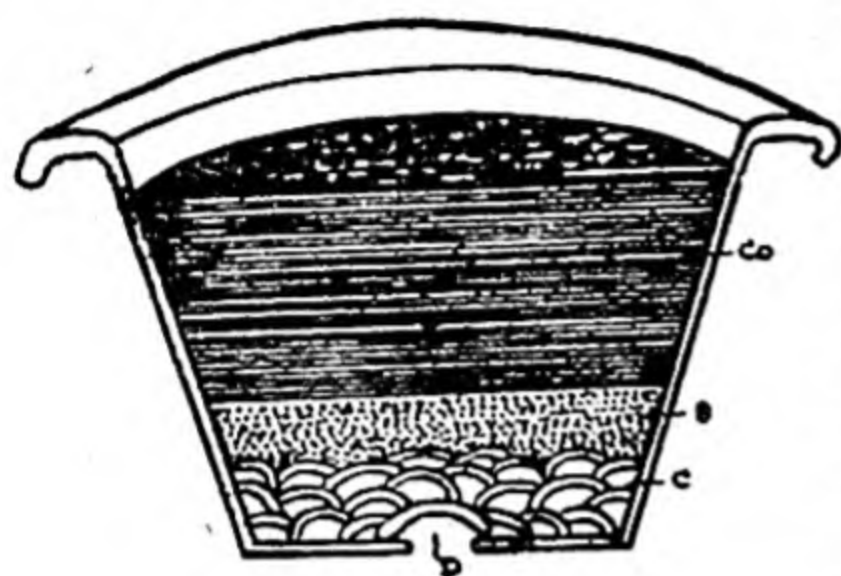


Fig. 58.

Section of a pot showing soil and the drainage.

D = Drain hole.

C = Crocks.

S = Sand.

Co = Compost.

each other with their hollow sides all turned downwards. These smaller pieces are then covered over with a layer of broken pieces of the size of a pea. Finally, the crocks are covered with a layer of coarse sand or cocoanut fibre to prevent fine soil from getting washed down into the drainage material and clogging it. For small pots up to six inches or so, drainage to a depth of $\frac{3}{4}$ inch will do. For larger pots up to 9 inches $1\frac{1}{2}$ –2 inch depth of drainage may be necessary.

Larger pots require a greater depth of drainage material. Pots for Orchids, which require perfect drainage, have nearly $\frac{1}{4}$ to $\frac{1}{3}$ or their depth filled with crocks.

How potting is done : After the pot is thus filled with crocks, suitable compost is put in to a sufficient depth with its



Fig. 58 A.

centre somewhat elevated to a point. Fine sand is sprinkled on the soil; the plant is held in the centre and its roots are

carefully distributed round the conically shaped soil; fine sand is again sprinkled on the roots covering them; then compost is put all round, gently firming it as each layer is put in, till about half an inch of space is left on top in the case of small pots and correspondingly more in the case of larger pots.

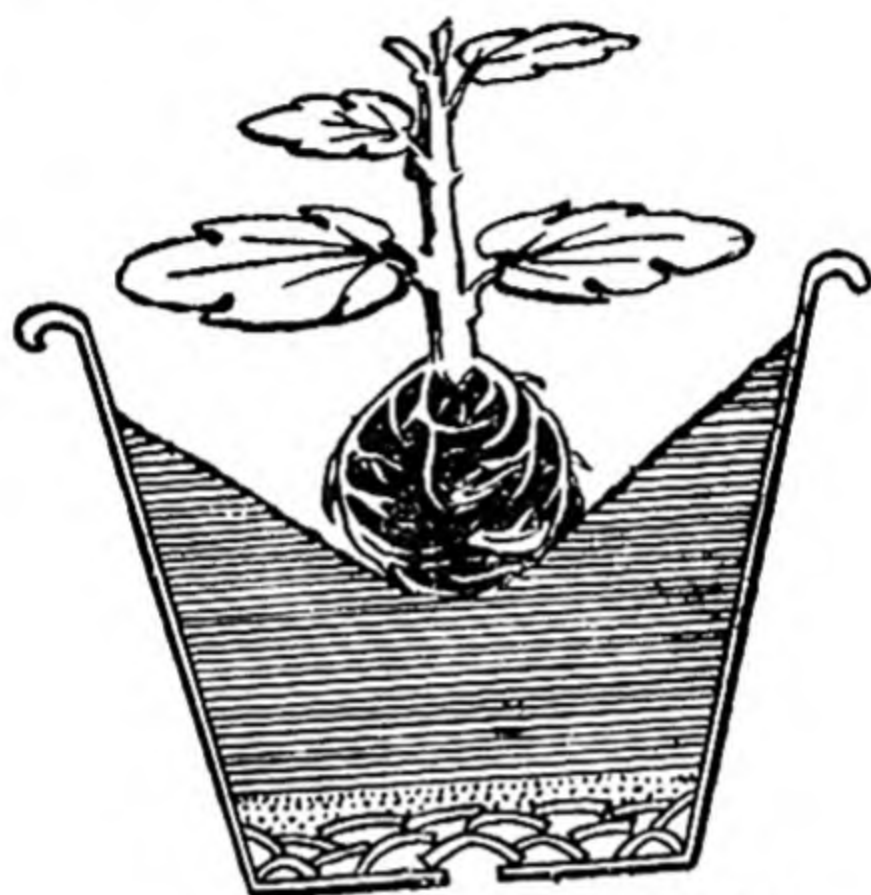


Fig. 58 B — Incorrect Potting.

When the potting is finished, the level of the soil is up to the first pair of true leaves in the case of seedlings, and up to the level of the mark on the stem showing the depth up to which the stem was in the ground or pot previously, in the case of all other plants replanted.

Repotting why and how done : Repotting of a plant is done for one of three purposes. A growing plant soon fills the pot with its roots and often needs a larger pot for satisfactorily continuing its growth. It is then 'shifted' to the next larger sized pot with its roots and soil intact. This operation can be done at any time of the year provided the plant is in a growing condition and its roots are ready to take possession of the new soil. Repotting is also done when the soil has got old and turned sour, in which case the ball of earth is broken up to free the roots from as much of the old soil as the safety of the plant permits. Repotting is again done, to provide fresh rich soil for the roots; these are cut back, the ball of earth is reduced in size, and the plant is put again into the same pot. Repotting which involves the breaking the ball

of earth and disturbance of the roots is only undertaken when the roots are beginning an active growth and not when they are dormant or resting.

Repotting : Repotting is done as follows :—The plant to be repotted is watered an hour or so before the operation for easy removal of the ball of earth from the pot. If the

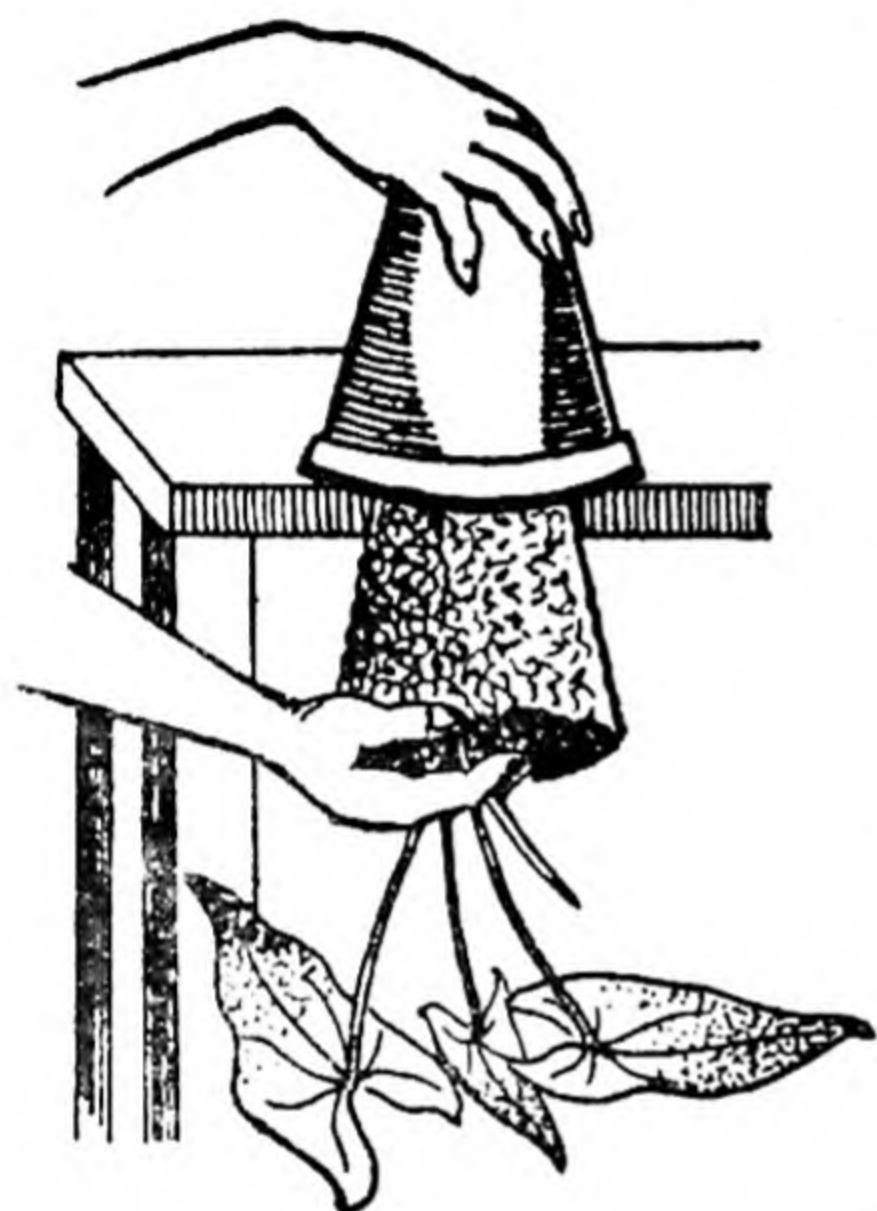


Fig. 59.

soil is dry, it is just likely the ball of earth will not come out easily and the plant will have to be pulled out damaging a number of roots. The soil is rendered too moist and is liable to give way while being turned out, if watered immediately before repotting. Keeping the right hand under the surface of the soil and holding the pot in an inverted position with the plant between the first and second fingers, the rim of the pot is gently tapped against a protruding object, such as the edge of the potting bench or the edge of another pot, keeping the other hand on top of the

inverted pot. The ball of earth comes out clean from the old pot; if however it does not come out the soil is pushed through the drain hole with the finger or a blunt stick to move it and still if it does not come out, the pot is broken to free the soil from it. All crocks under the ball of earth and all the superfluous and old soil are gently removed from the ball of earth all round, decayed and superfluous roots are clean cut out with a sharp knife, and some of the thickest roots are carefully drawn out of the ball of earth to establish in the new soil round the sides of the new and larger pot. Then the plant is potted as described above. Usually repotting is done into the next larger sized pot, allowing about an inch and a

half of new soil all round the old soil. If the roots are not many, after their necessary pruning back the plant is put into a new pot of the same size as before. Thus, the choice in the size of the new pot depends much on the nature of the plant itself and on the quantity of roots already present in the old soil. Soft-wooded plants require generally more fresh soil than hard-wooded plants. Plants with plenty of roots may not suffer much if they are put into a pot slightly too big for them.

The following are some important points that require to be attended to in potting or re-potting operation :—

1. Use clean pots : New pots should be soaked in water for about half an hour. Otherwise, they absorb too much of moisture from the soil preventing the newly potted plant from making any progress. Old pots should be scrubbed both inside and out with cocoanut fibre and even washed in hot water to remove all dirt and moss, which would otherwise prevent good æration of the soil. Cleaning also removes remnants of past disease, fungus spores, etc. But on no account should the pots be wetted immediately before use, as the new soil would stick to the pot and would interfere with æration.

2. Use clean crocks : Only clean crocks should be used. Old crocks should be well washed and freed from soil, lest it should be washed into the drainage of the new pot clogging it. Again, unclean crocks may infect the new plant with disease if it contains remnants of past disease.

3. Use suitable soil : It is necessary that each kind of plant should be grown in a soil mixture which is best suited for it.

4. Potting soil not to be quite dry : The potting soil should be used in a moderately moist condition. A handful of soil pressed firmly should mould itself to the shape of the hand without dripping moisture and should at the same time crumble when it is disturbed without being so dry as to fall to pieces when the pressure is released. If the soil is dry as dust, it cannot be easily worked and firmed. Further it will not be wetted entirely while being watered, as the water has a tendency to run down the sides without moistening the dry soil.

5. Pot firmly : With most plants, it is desirable to pot firmly. By firm potting is meant, pressing the soil in the pot to such an extent that the plant cannot be pulled out easily. But firm potting does certainly not mean ramming the soil down very hard.

As a general rule it might be stated that soft-wooded plants require less pressure or less firm soil, while hard-wooded plants require a corresponding degree of greater firmness. Palms, Roses, Crotons, etc., require the soil to be well firmed. Geraniums and Carnations do not thrive if the soil is too loose. Plants with fleshy roots generally require a comparatively loose compost. Soon after potting, watering is done through a fine-rosed can to settle the soil down round the roots.

6. Allow space at top for watering : After firming the soil, there should be about half an inch of space in the case of smaller and one inch in the case of larger pots, at the top for affording sufficient room for watering.

7. Wet the soil before repotting : Plants should never be repotted when the earth holding their roots is quite or nearly dry; it seldom gets soaked afterwards, when surrounded with soil of a moist nature through which water passes readily, leaving the dry part to remain as before. The plant to be repotted may be watered two to three hours before repotting.

8. Don't use oversized pots : It is necessary to use some judgment in choosing the pot. It is safer to put a plant in a pot slightly too small than too large for it. A plant in a pot too large for it with plenty of inert soil about its roots is in far greater danger of being injured by careless watering than a plant in a small pot filled with active roots. The latter soon recovers from wilting when it is watered but an overpotted plant which gets into bad condition by waterlogging and consequent sourness of soil seldom recovers. Unless there is fear of plant getting potbound, that is, of becoming stunted in growth on account of roots filling all the soil and suffering for want of more root space, a plant is grown in the same pot, putting it back into the same pot at each repotting. Plants in small pots, when they grow and fill the pots with roots, are moved to next larger sized pots or those which are not

more than two or three sizes larger than the old one.

As soft-wooded plants are generally vigorous growers, they are safer put into proportionately larger pots than would be desirable for slow growing hard-wooded plants.

9. Don't plant too deep : Too deep potting is very harmful, especially to hard-wooded plants. Too shallow potting is likewise injurious as roots will not get a firm hold on the soil and will get shaken with every breath of wind. It is always safe to plant in such a way that the old ball of earth is not placed lower than what it had been previously.

10. Remove to shade after potting : After potting, the plants should be removed to a shady place until root action commences afresh. After they are established, they are gradually hardened by admitting more and more sun to them, before they are actually put in the open.

11. 'Plunge' pots which are in sunny situations : Pots left in exposed situations, especially those in which plants with large soft leaves are grown, are best plunged up to the brim into the ground or into larger pots with intervening space filled up with ashes or sand. This would prevent the sides from heating up and injuring tender roots. Plunging would also help to minimise evaporation of moisture and thus keep the soil, as far as possible, in an equable condition.

12. Feed by top dressing or with liquid manures : The soil in the pot soon gets exhausted, partly due to its nutritive contents being washed away by streams of excess water percolating through the soil after moistening it and coming out of the drain holes, and partly by their being used up speedily by the growing plant. Hence, pot plants should be supplied with necessary food now and then. This is done in one of two ways, by *top-dressing* with rich soil or by applications of liquid manure. Top-dressing consists in the removal of one to three inches of old soil from the top of the pot without damaging the roots and replacing it with a fresh compost, particularly rich in manure. How liquid manure is applied has been dealt in Chapter IV.

13. Examine occasionally for grubs : The soil has to be examined now and then for grubs, which are very destructive on roots, ultimately causing the plants to die. When a plant

looks unhealthy and its leaves are turning yellow and the soil is loose and holds moisture, one may expect grubs in the pot. No satisfactory and safe method of killing these worms of the soil has been found. The only remedy is hand-picking, which very often means disturbing the root system of the plant. When the soil is full of grubs, it is safest to pull out the plant and replant it in new soil.

14. Prune before repotting : Plants are best pruned, sometime before they are actually repotted, allowing the new shoots to develop to some extent by that time. In the case of roses and some other plants however, pruning is done after repotting, when the sap is rising satisfactorily and the temporary set-back received during repotting is overcome.

15. Exercise care in watering : Pot plants require to be watered much more carefully than those growing in the ground. Two common mistakes in watering pot plants are, applying too little or too much of it. If the watering is in excess of the requirements of the plant, the soil becomes sour for want of aeration. So, the soil can be prevented from turning sour by allowing it to run dry, but not so dry as to cause flagging of the plants. When the soil is quite dry, the danger is that any water applied runs through straight without soaking the soil. In this condition, it is best to leave the pot in a tub of water for sometime. If there is not enough space at the top of the soil, watering will have to be done twice at intervals of quarter of an hour or so. A good rule in watering pot plants is to do so only when the soil is fairly dry or when the plant is likely to suffer if it is not watered within a short time. Another good rule is to water thoroughly, if at all. One should not go about watering every pot equally. The needs of particular plants vary. Freshly potted plants, as seedlings and rooted cuttings, etc., require particular care in watering, as they easily suffer by either excess or deficiency of water. If the soil in the pot is moist, a dull thud is caused by gently knocking the side of the pot with the knuckle. If the soil is dry, a sort of metallic sound is produced. The weight of the pot ; when it is lifted, will also give an indication of the moisture in the soil. When the soil is approaching dryness, only so much of water is applied which is just enough

to soak through the entire soil without overflowing through the drain holes. Excessive applications will result in impoverishing the soil very soon, by taking out of the soil, dissolved food elements, each time the watering is done. It is advisable not to water the pots when they are heated up by the sun. The hot hours of the day are to be avoided for purposes of watering. Certain plants require to be watered twice a day, especially in summer.

16. Keep away termites and earthworms : To prevent earthworms and termites from entering the pots through the drain holes, place them on a couple of bricks laid side by side or place pots on three stones placed triangular-wise or on stone steps. Earthworms, by their ramifications in the soil, disturb the drainage, as a result of which the plants suffer in due course.

17. Fork the soil occasionally : If the soil gets hard and crusty on the surface, it is stirred with a wooden splinter or a dibber-like material to a depth of $\frac{1}{4}$ - $\frac{3}{4}$ inch, not only to facilitate water to penetrate the soil but also to aerate it.

SOIL FOR POT PLANTS

Soil mixtures—their constituents : The soil for pot plants, called the 'compost' consists of a mixture of earth, manure and other materials which are evenly distributed in it. As the compost plays a very important part in the life of a plant, as it is the medium which supplies water, food and air to the roots, no pains should be spared to provide the best soil mixture for the plant. As the needs of different classes of plants vary, composts should be varied accordingly. The ingredients which usually enter into composts are loam, leaf-mould, manure, sand, charcoal, brick pieces and mortar rubble. The proportion of the several ingredients in the made-up soil is varied so that its texture and manurial value may be suited to the needs of each class of plants. Loam, generally, forms the basis of all potting soils. In our country, red earth, which is a kind of fairly heavy loam containing iron, is used. It should however not be so heavy as to be sticky like clay. Generally, horse and not cow-manure is used in our composts.

In the absence of horse manure, cow or cattle manure may be used for composting, with slightly increased proportion of sand and earth. The manure should have been well decomposed. Leaf-mould should have been thoroughly decayed and sieved through quarter inch meshes. Leaf-mould serves to render the soil porous and it also modifies the heat during decomposition of the horse manure in the compost and makes it safe for tender roots of plants. River sand should be used. It should not be very fine. Its particles should be large enough to render the soil porous even after it is well pressed in the pot. Brick pieces and mortar rubble are used for making the soil porous to a high degree, as is required in the cultivation of such plants as Cacti, Orchids, epiphytes like *Billbergia*, etc. Charcoal has a charm for roots. It renders the soil porous like brick pieces; it helps it to remain sweet and not turn sour; it helps to prevent to some extent stagnation of water at the roots and it also prevents the plant from suffering from drought. Bone meal has an excellent slow manuring value and on account of its slow but sure action, it is used in almost all composts for pot plants which are not repotted to bigger sizes too often.

The following are some soil mixtures which are used for growing particular classes of plants mentioned below :—

1. *Annuals :*

3 parts Horse manure
1 ,, ... Red earth
1½ ,, ... Sand

2. *Soft-wooded flower plants such as Geranium, Violet, etc. :*

6 parts Horse manure
4 ,, ... Red earth
3 ,, ... Sand
2 ,, ... Leaf-mould

3. *Bulbs and Tubers such as Canna, Dahlia, etc. :*

2 parts Red earth
2 ,, ... Sand
2 ,, ... Leaf-mould

2 parts Manure
1 ,, ... Loam
¼ ,, ... Charcoal

4. *Roses :*

6 parts Horse manure
4 ,, ... Red earth
3 ,, ... Sand
2 ,, ... Leaf-mould or
 Cow manure

5. *Crotons :*

4 parts Red earth
4 ,, ... Horse manure
3 ,, ... Sand
2 ,, ... Leaf-mould
1 ,, ... Lime rubbish

6. *Plams* :

- 4 parts Leaf-mould
 3 „ Red earth
 3 „ Sand
 2 „ Loam
 2 „ Horse manure

7. *Ferns* :

- 4 parts Leaf-mould
 3 „ Sand
 2 „ Loam
 2 „ Horse manure
 1 „ Brick pieces
 1 „ Lime rubbish
 $\frac{1}{2}$ „ Charcoal

8. *Begonias* :

- 4 parts Red earth
 4 „ Horse manure
 4 „ Leaf-mould
 3 „ Sand
 1 „ Lime rubbish
 1 „ Charcoal

9. *Caladiums* :

- 4 parts Red earth
 4 „ Horse manure
 4 „ Leaf-mould
 3 „ Sand
 1 „ Lime rubbish
 $\frac{1}{2}$ „ Charcoal

10. *Dracænas* :

- 4 parts Leaf-mould
 3 „ Sand
 2 „ Loam
 2 „ Horse manure
 $\frac{1}{2}$ „ Charcoal

11. *Dineffebachia and similar tropical foliage plants* :

- 4 parts Leaf-mould
 2 „ Sand
 1 „ Loam

- 1 part Peat moss
 (chopped)

- 1 „ Manure
 $\frac{1}{4}$ „ Brick dust
 $\frac{1}{2}$ „ Charcoal

12. *Anthurium, Philodendron, etc.* :

- 4 parts Leaf-mould
 2 „ Sand
 1 „ Manure
 1 „ Charcoal
 1 „ Brick dust
 1 „ Peat moss

13. *Orchids generally* :

- 4 parts Peat moss
 2 „ Brick pieces
 1 „ Charcoal
 1 „ Light tank silt
 1 „ Leaf-mould

14. *Succulents* :

- 2 parts Red earth and
 Loam

- 2 „ Leaf-mould
 1 „ Sand
 1 „ Horse manure
 1 „ Lime rubbish

15. *Ornamental shrubs and creepers* :

- 5 parts Red earth
 4 „ Sand
 4 „ Horse manure
 2 „ Leaf-mould

16. *Fruit Plants* :

- 4 parts Red earth
 2 „ Sand
 1 „ Horse manure
 1 „ Sheep manure

17. *Soft and Hard-wood cuttings* :

1 part	Leaf-mould	1½ parts	Red earth
1½ „	Red earth	1½ „	Sand
1 „	Sand	½ „	Powdered charcoal
18. <i>Seed-sowing :</i>			
3 parts	Leaf-mould		

How compost is made : Compost is made by spreading the ingredients, layer by layer, one above the other in their respective proportions, moistening it slightly after each layer or material is put. For instance the compost for annuals mentioned above is made by spreading 3 baskets of manure on the ground, 1 of red earth over this, and 1½ of sand over the latter. This is continued till a large heap is made. If the layers are not moistened at the time of forming the heap, a depression is made on it to hold water, which is poured slowly to soak the soil through. The compost should be prepared in this manner 2–3 months before it is wanted for use, and stored under cover or under the shade of a large tree. Potting soil, if used in a too fresh condition, is likely to burn the tender roots of delicate plants. The heap should be turned over and the ingredients well mixed, before use, so that they may be evenly distributed in the soil. The organic material should be well decayed. Grubs should be searched for and picked out while turning over the compost.

CHAPTER X

PRUNING

Principle of pruning : The general principle underlying pruning is the encouragement of the plant sap to flow towards certain desired parts of the plant, such as the stem, leaf or roots, to promote their growth and vigour by removing certain other parts which are not wanted and for the growth of which plant-sap would be wasted. The removal of certain parts of the plant results in the lessening of the struggle for existence among the remaining parts of the plant, more nourishment being distributed to them after pruning. Pruning thus is an invigorating process, calculated to produce a definite effect in the formation of shoots, flowers, fruits, and roots too. Pruning is an important operation, which if neglected, very often results in plants losing their condition. The necessity for pruning is readily observed by comparing a regularly pruned rose bush with one left to take care of itself. The former bears large fine blooms on strong and healthy shoots. The latter is unhealthy and produces straggling weak shoots bearing miserable specimens of blooms. The necessity for pruning is also observed in the case of other shrubs, trees, and plants, whether cultivated for their fruits or for their flowers. In the case even of annuals, like Balsams, the flowers produced on plants grown to a single stem or with only two or three side shoots are larger and superior to those produced by plants with a number of shoots on them. In a bunch of two or more fruits or in a cluster of two or more flowers, if only one fruit or flower bud is retained and the others removed, a large sized fruit or flower is obtained. Similarly, by thinning out some branches of a tree or shrub, the others grow vigorously. Pruning would easily become a mischievous operation, if ill done. Drastic pruning or too frequent pruning very often kills a plant instead of improving it. The method and the time of pruning should be suited to the climatic conditions and varied with the character and habit of the particular classes of plants. For instance hard pruning is done in temperate

climate while the plant is in a dormant condition to stimulate growth but that would kill the plant in a tropical climate where plants make vegetative growth throughout the year and any removal in bulk of their foliage will result in a setback to the functioning and growth of their roots causing them to die. Very often the idiosyncrasies of a particular variety will have to be studied before putting the knife upon the plant. Broad principles can however be laid down for the guidance of the amateur and these should be necessarily modified to the requirements of particular plants.

Purposes of pruning : It is not every tree, or shrub or plant that requires pruning. It is not a haphazard cutting and mutilation of the parts of a plant, which would endanger its life. It is a scientific operation performed with one or more of the following definite objects in view :—

(i) To train or shape the tree or shrub or plant to some desired form or size, by cutting away all growths tending to depart from it, as in trying to produce topiary effect, trimming hedges, making standards etc.

(ii) To encourage vigorous growths in and to admit air and light to parts retained, by removing superfluous or overcrowding or thin and weak branches from a tree, shrub or plant.

(iii) To change the habit of wood-production to the production of greater number of flowers or fruits of larger size and superior quality. The concentration of vigour to certain parts "pushes" flower or fruit buds. Reduction of unwanted growths by thinning and disbudding vegetative, flower or fruit buds results in improved quality and probably in quantity also.

(iv) To rid plants of fungus diseases and insect pests by cutting away all dead and badly affected parts.

(v) To improve the health and increase the vitality of old and sickly trees and shrubs by a shortening of the branches and a general reduction in their heads.

(vi) To increase flower and fruit production by checking the growth of a tree or shrub by cutting away a portion of its roots. This is effected by root-pruning and also sometimes by girdling or ringing.

Prune in right season : The purpose of pruning may be entirely defeated by pruning at the wrong season. As a general rule, it may be mentioned that pruning should only be done when the plants are least active in growth or resting. Deciduous shrubs are mostly dormant from the time they shed their leaves till they break out again with fresh foliage. They are best pruned about a month after the falling of their leaves and the growing season sets in. In the case of other plants, pruning is done some days after flowering is finished, as they are then least active in growth.

The time for pruning is often easily determined by ascertaining the flower-bearing habit of the plant, according as it blooms on the shoots of the last season or on the new wood of the present season. The time when the plant blooms, gives a rough idea when to prune. Most of the shrubs which bloom in spring, that is in February-March, produce their blooms on wood made in the last season and their buds are perfected before the winter and remain dormant then. This is true of a large number of evergreen shrubs which require as long a season of growth as possible for production of blooms and those deciduous shrubs which bloom on wood made during the preceding year. They are best pruned just after the flowering season. But, those shrubs, which flower on their current season's growth as *Hydrangea*, *Hibiscus*, *Jasminum*, etc., are encouraged to produce greater quantity of fresh wood by pruning in winter or early spring, that is, in December to February. Pruning is done by cutting back the shoots to one or more buds, according to the requirements of the particular kind of plant, from the point of their origin, some kinds standing severer pruning than others. Pruning does not consist in the entire removal of the shoots that have flowered or in cutting back the plant indiscriminately low down.

The following points are worth noting in pruning operations:

1. Clean cut necessary : In all pruning operations, a clean cut should be made. For this purpose a pruning knife with a sharp edge is essential, for cutting small stems. For larger ones, secateurs, which cut the wood clean and not pinch and flatten out the wood before cutting, are to be chosen. A hand saw is necessary for cutting still larger branches or stems.

After the cut is made with the saw, the rough surface should be smoothened with a sharp knife, so that the wound may heal rapidly.

2. How a cut is made : The shoot should be removed by means of a clear straight cut, with a sharp instrument by making a sloping wound, forming an angle of 45 degrees, just at the back of a bud, as shown in *b.* in fig. 60, which shows correct pruning.

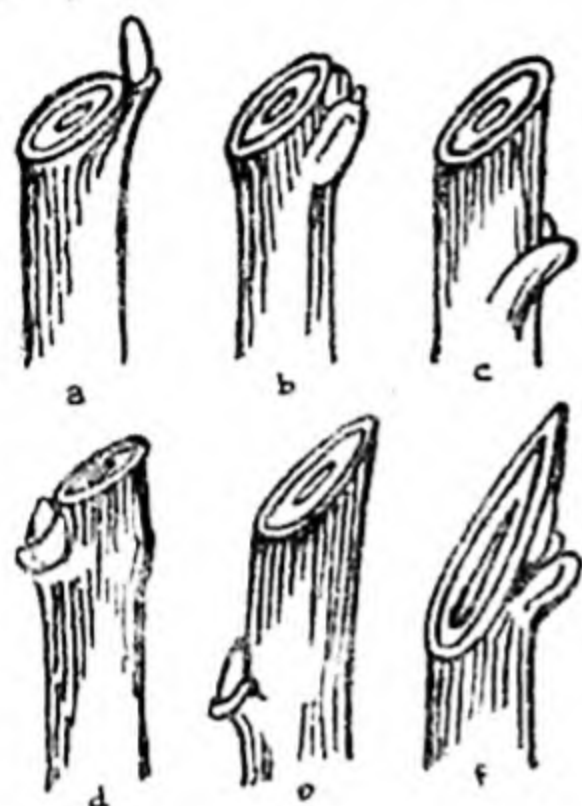


Fig. 60.

Pruning—Good and bad pruning.

b = Correct cut: all others are bad cuts.

The cut is seen to enter on a level with the base of the bud on the side of the shoot opposite to the bud and pass out on a level with its top, slanting slightly across the shoot. Such a clean cut rapidly becomes covered over with new growth as the bud pushes. All the other figures *a*, *c*, *d*, *e* and *f*, show bad pruning. In figure *a*, the wound is made too low down and it exposes the communication between the base of the bud and the interior of the stem to the drying action of air, as a consequence of which the bud dies. Figures *c*, *d* and *e* are bad cuts, as they would leave a portion of the branch above the bud, which would die in course of time and would have to be removed. It may also cause the shoot to die back. Figure *f*, illustrates an ugly and a dangerous cut which injures the branch on which it is made. These figures are taken from Lindley's *Theory and Practice of Horticulture*.

3. Prune to keep the centre of the plant open : The bud to which the cut is made should face away from the centre of the plant. The new growth will tend to follow the direction at which it is pointing. It is always desirable to keep the centre of the plant open to sun and air and for this purpose the limbs should be made to grow outwards by cutting to the bud pointing outwards.

4. Don't leave stubs : In amputating large branches of trees and shrubs, care should be taken to remove them close

to the branch or trunk from which they start and the cut should be as parallel with such branch or trunk as is practically possible, as seen in fig. 61. In no case should stubs be allowed to remain, as they do not heal readily and give rise to fungus infection which spreads from the decayed wood into the interior of the branch giving rise to cankers.

5. Seal the cut surfaces : A very necessary operation after pruning is to smoothen all jagged cuts, if there be any, with a sharp knife. When this is completed, the wounds, unless they are very small on tiny twigs, should be dressed with something to seal the closed ends. A thin splash of tar, or better still, a coat of white lead is used for this purpose. Neglect in sealing the wounds may cause injury by 'bleeding' (that is the sap oozing out through the cut end of the stem), besides leaving easy access for fungus diseases and borers.



Fig. 61.

Cut along *cc* in a line parallel with the branch at a fork, leaving no stump.

6. How pruning is done : Pruning is started by cutting off all dead wood, diseased growths, and thin and weak twigs, etc. Then all growths which intertwine cutting off air and light to desired parts are removed. Generally, weak shoots are cut back severer than strong ones. After deciding upon the framework to be retained, the shoots are cut back to desired number of buds, keeping in mind that cuts are to be made only above buds, pointing away from the centre of the plant. In thinning buds, leaf buds should be distinguished from fruit buds. The former are usually more pointed than rounded.

7. Tree pruning : Tree pruning is done only very rarely. A tree usually assumes a definite form which is characteristic of the species. Trimming of a tree is rendered necessary only to curtail its encroachment over a place which cannot be permitted or to remedy an uncouth shape. It is however imperative when a tree has been damaged in some of its parts as for instance by a storm. It is often necessary to train a young tree form to a substantial framework for a future large tree.

Ordinarily, it is not desirable to have in a garden a tree which begins to branch lower than 1.5–2 metres from the ground level. It would obstruct the view and prevent the enjoyment of parts of the garden. Seedlings are planted out in their places permanently and allowed to grow at the top removing all side growths. If however, a number of vigorous growths emerge from the stem, one of them, the strongest and the straightest growing, is retained and staked. In course of time, this shoot takes a vertical growth in a line with the old stem without showing any bend. In a few cases, as in *Millingtonia hortensis*, *Cassia* species and *Spathodea*, vigorous sucker-like tall growths are produced, one of which is retained as the trunk for the future tree. All side growths are removed from the stem till it reaches a height of about twelve to fourteen feet. The terminal growth is arrested by cutting away the top of the stem just above a node. This 'heading' induces formation of a number of shoots. Out of these, four strong ones are selected, which grow towards the four directions, and which are above ten feet from the ground to form the framework of the tree. In selecting the shoots to be retained, care is taken that any two of the retained shoots are not placed on a line opposite each other. If they 'fork' at any place, they have a tendency to split during stormy weather. The stem is well supported by providing it with a stout bamboo stake.

8. Pruning fruit trees : In this country, fruit trees do not require to be regularly pruned. Tropical and semi-tropical fruit trees as Mango, Litchi, etc. are pruned only with a view to thin out the centre, should the branches overcrowd each other. During the early stages—the first three or four years after planting—a few shoots may need to be cut out and one or two induced to grow here and there to give shape and to form the foundation or framework of a strong tree with properly spaced branches. They should originate at least $\frac{1}{2}$ to 1 metre above the ground from the trunk and be placed fairly wide apart at different heights on all its sides. Three to six such suitably placed branches may be enough to form a strong well balanced tree which will in course of time send out laterals from the main branches. If laterals are not formed, their formation may be induced by heading back the main

branches. Young trees should not be allowed to bear flower or fruit much too soon, as they would be seriously stunted and their useful life greatly shortened. Fruit production places the tree under a great strain; a young tree cannot be expected to make plenty of new growth and at the same time bear heavy crops of fruits. It is best fruit plants are not allowed to crop till they are three to five years old.

9. Some amount of regular pruning may be necessary in the case of such temperate trees as Apples, Pears, Plums, Apricots, etc., on hill stations. Each kind has a law of pruning for itself, depending upon the nature of its growth and upon how its flower buds or spurs are borne. Generally, it might be mentioned that pruning of such trees follows two main lines; first, that which is directed to encourage the production of new wood, which is effected chiefly by pruning the main branches or the leaders of the tree and secondly, that which is necessary to induce fruitfulness, which is effected by pruning subsidiary growths or the laterals. In our country, with its hot enervating climate, pruning if done at all, should be very light. In temperate climates and on hill stations in India, for promoting vigorous new growths, which is of the highest importance in the case of bush trees, the main shoots or leaders as they are called are shortened by half to two thirds of their length. All cuts are made above a bud which points outwards, with the result that the tree assumes the form of a goblet with the centre open to sun and air. The thinner side growths, or laterals as they are called, which bear the fruits are treated differently. They are discouraged from producing wood growths and encouraged to produce fruit spurs, by shortening each lateral to two or three buds of its base. In the next season, the buds plump up and produce flowers or produce a short shoot bearing a terminal flower. If it results only in a vigorous leafy shoot, the shoot is again cut back to one or two buds. Pruning, done in the manner described above, helps to retain the plant in a bearing condition. Pruning of fruit trees is a subject by itself and is not within the scope of this book.

10. **Root pruning** : Root pruning is resorted to as a last measure in the case of fruit trees which show a tendency

to make free growth and produce very little or no fruit, after trying manuring with superphosphate and ring-barking, Root pruning needs exercise of great skill and care, to be really beneficial. Mere ruthless hacking of the roots of the tree will kill it.

*The operation is carried out as follows:—*A trench, three feet wide and about three feet deep is made half way round the tree. While digging down, care is taken not to injure the fibrous roots which cross the trench; they are tied into bundles and covered over with a mat or some other material shielding them from the effects of sun and the drying action of air. If no roots are come across even after digging down to a depth of two to three feet, the soil is gently worked till the roots are reached. Keeping only a few of the larger roots, which are absolutely necessary to anchor the tree and to prevent it from toppling over during stormy weather, roots above the thickness of an inch are clean cut off, the cuts being effected upwards to help formation of fibrous feeding roots on the surface, quite within the reach of the manure and water applied. The idea of root-pruning is to sever as many deep going tap and other large roots as is consistent with safety, to induce the formation of a mass of fibrous roots at their cut ends, which absorb manure laid on the surface. The trench is then filled up with good loam, to which may be added well decomposed manure. The roots of a tree usually spread as far as its branches and this fact furnishes a safe guide for fixing the position of the trench for root pruning. It is safe not to prune all round the tree at one time. Root pruning is best done in two stages; roots on one side, being pruned one year and those on the other side, the next year. November to January seems to be the best time for this operation.

11. Ringing or girdling: This is effected by removing a quarter to half an inch in bark in a circle on the stem. The sap ascending the stem stops at the part operated upon and the descending sap collects there to form a callus. If the tree has reached the fruit-bearing stage, fruit buds appear in place of leaf-buds, during the following fruiting season. Ringing is best done during the monsoon period. A wire tied very firmly round the stem, serves the same purpose as ring-barking.

It should however be removed after a period of six months. Ringing is a drastic operation which may result in the killing of the branch or stem operated upon, and should be adopted only as a last resort in the case of trees which fail to fruit.

12. 'Wintering' : In the hot parts of India, where it may be dangerous to root-prune trees and shrubs, with a view to force them to bear flowers and fruits, they are *wintered*. Wintering is done in connection with such flowering shrubs as Roses, Jasmine, etc., a majority of deciduous fruit trees such as apple, peach, plum and grape vine. In the resting season, water is stopped gradually to the trees or shrubs, the soil above their roots is removed exposing them to the sun for three to fifteen days according to the age and the hardy nature of the plants concerned. The roots are then covered over with the same soil, enriched with manure or with fresh compost. Watering is then copiously done. The leaves begin to turn yellow and fall off and those that are still on the plants are stripped off the shoots. The sap which had gone down to the roots when the plants were wintered, begins to rise with the supply of water and soon leaf and flower buds swell, bearing shoots and flowers.

CHAPTER XI

PLANT DISEASES AND ENEMIES

Introductory : Innumerable diseases and enemies attack plants, causing them greater or less injury. Most diseases are caused by small microscopic bacteria, fungi, depredating insects, and disease-causing agents known as virus. Diseases are very often physiological and brought on by disturbed nutrition, deficiency of required mineral foods, enzymic activity, faulty culture, and unsuitable soil, light and other environmental conditions. Most diseases and pests are not difficult to cope with by proper vigilance and adoption of suitable remedial measures. It would be wiser to keep off pests and diseases by protective measures, as for instance, good cultivation, spraying with preventive fungicides and repellants, immunization by establishing within the plant itself some condition which renders it immune or resistant to the attacks of pathogens. Careful selection and propagation from disease-free and disease-resistant stock and acclimatisation make plants immune to disease. All civilised governments forbid the importation of plants affected with dangerous insects and fungi and bacteria into areas and regions where they do not occur. But, in spite of the best precautionary and other measures, diseases and pests do appear and cause havoc to plants. As they increase and spread rapidly, immediate steps should be taken to overcome them.

CONTROL OF FUNGUS PESTS

Nature of fungus attacks : The harm done to plants by fungoid diseases is often more considerable than the mischief of insects. The greyish coating on the foliage of roses, peas, balsams, grape vine and many other plants, which weakens and often kills them, is due to the attack of a fungus, which is well known as the 'mildew'. Yellowish or orange-coloured swellings are seen on branches and branchlets of jasmines and Citrus plants, from which the plants very much suffer. Large

branches and trunks of trees decay and die of canker and rot which set in when the wounds caused while pruning or by injuries are not dressed. Seedlings are often noticed to "damp off". Carnation stems and roots rot suddenly. Swellings are often noticed on the roots and stem of several fruit trees as apples, roses and several ornamental plants, which are responsible for their eventual death. All these are due to fungoid pests of different kinds. At times, even the most observant cultivator may find it difficult to detect the presence of fungus till appreciable destruction has been caused by them, as they are too small to be seen with the naked eye. Fungi begin as tiny specks on parts of plants and carry on disease and death very rapidly.

What fungi are : Fungi are microscopic plants of a low order. They are devoid of chlorophyll, the green colouring matter of plants. Hence, fungi are unable to utilise sunlight as a source of energy for food assimilation. They can neither take in carbonic acid gas from the atmosphere nor absorb nitrogen. They have, therefore, to get their carbonaceous and nitrogenous food from other sources, chiefly from dead or living plants, which have them in a ready form. Fungi are broadly put under two distinct groups :— (1) Parasitic fungi, such as mildew, which get their food from living plants. (2) Saprophytic fungi, which exist on and derive their food from dead plants or other organic material. Mushrooms are examples of saprophytic fungi. Obviously, parasitic fungi are most dangerous to the growth of plants, inflicting serious loss unless checked in time.

Effect of fungus attack : As noticed above, all parts of plants—roots, stem, branches, leaves, flowers, fruits—are liable to be attacked by fungi, resulting in the gradual weakening, decay and death of those parts and even in the death of the entire plant itself by the general arresting of the physiological functions of its essential organs.

Fungi exist in multifarious kinds which select particular classes and kinds and particular parts of plants for attack at various stages of their growth in characteristic ways and are thus capable of being classified into recognisable types.

Thickenings, deformities, discolourations, dwarfing and

rots are some of the manifestations of attack by fungi. Leaf diseases appear as localised lesions in the form of spots, streaks, patches and discolourations, resulting very often in entire defoliation. Withering of tips, die-back of twigs and branches, general decay of entire stem after injuries to part of it, cankers, rots on bark are some of the indications of stem diseases. Sudden collapse and wilting of the entire plant, rotting and swelling of roots are indications of root diseases. Blossom blights cause the falling off of flowers without setting fruits. Fruits may become spotted, scabbed, develop cracks and rots and thus rendered useless.

How fungi spread : Fungi increase by spores which are minute cells. The body of the fungus, which is called the *mycelium*, is thread-like and much branched. The threads composing the mycelium are known as the *hyphæ* and they are the organs which draw nourishment from the host plant. The mycelium or the hyphæ may be one or more celled. They give rise to spores which correspond to seeds without embryos of the higher order of plants. Spores are carried from place to place by wind and water and they germinate on suitable plant tissue. They absorb moisture, swell, and send out germ-tubes which penetrate the host plants and become the mycelium, when they lengthen and branch out.

How fungus attacks can be prevented : Weak plants fall a prey to fungi more readily than strong healthy specimens. Proper attention to plant sanitation checks the on-coming of disease. Good cultivation and cleanliness are primary essentials. Plants should have a plentiful supply of air and light and regular and suitable supplies of water. Too much of moisture at the roots or excessive humidity of atmosphere round the plants often brings on fungus attacks, especially the damping-off of seedlings and mildew. Want of proper drainage in the soil, deficiency of potassium, phosphorus and other foods in it, sudden changes of temperature during day and night, extremes of weather conditions brought about by rains following drought, overcrowding, growing of same crops in the same plot of ground successively, are some of the causes for the outbreak and spread of fungus diseases. All cut surfaces, after operations like pruning, should be protected from fungus

getting a hold on the plant by smearing them with white lead or a thin splash of coal tar. Diseased plants or parts of plants should be burnt and not merely thrown away. Diseased leaves, branches, etc., should never be thrown away into manure pits as they assuredly spread disease among healthy plants in the following season. Alternation of crops tends to put down the spread of many kinds of fungus, more especially in root-crops and annual plants; some diseases remain in the soil and attack the same kind of plants, if grown in it season after season. Soil infected with dangerous fungi is best replaced to the depth the diseased roots have travelled. Otherwise, it should be disinfected by freely incorporating lime into it. In all such cases, it is best to dig in lime freely, leave the land fallow, exposing the soil to the action of sunlight and air for a period of about four months. In all cases where fungoid attacks are commonly apprehended, preventive spraying with a standard fungicide, is a very helpful protective measure. It is an insurance against disease in the cultivation of citrus trees, apples, pears, peaches, grape vine and the like whose foliage and young shoots and fruits are susceptible to attacks by several kinds of fungi.

Familiar fungus diseases : Fungoid diseases afflicting fruits, vegetables, and ornamental plants are so many that it is impossible to refer to every one of them here. The following enumeration will give a general idea of the nature of the common pests.

Mildews Blights : The foliage of Roses, Sweet Peas, Balsam, Grape-vine, Apple, etc., are sometimes coated with a whitish ash-coloured powdery dust or downy masses, which in due course cause the leaves to fall off, young shoots to wilt and perish, and prevent buds from developing or opening out into blossoms. This is characteristic of the mildews and blights which exist as several parasitical genera, species, and varieties, attacking different species of plants. They begin as minute dots and spread rapidly. Great difference between day and night temperatures generally brings on the attack. Preventive sprays with Bordeaux mixture are very helpful in keeping off attacks. Remedial measures are practically useless unless taken in hand immediately the attack is suspected. Badly affected

parts are best cut out if possible and all affected leaves, etc., collected and burnt. The best known and effective remedy against all mildews and blights is Bordeaux mixture which is sprayed on the affected plant entirely. Dusting with flowers-of-sulphur or spraying with lime-sulphur or potassium sulphide solutions or epsom salt is more helpful, however, against the powdery type of mildew.

Rust : There are several kinds of rust, attacking particular kinds of plants. The disease reveals itself by rusty yellow or orange or brown or dark spots and blotches on the epidermis of the stem in most cases and in some on leaves also. Rusts are very harmful and they are difficult to eradicate after they get hold of the plant. Attention to plant sanitation, good cultivation and preventive spraying are the usual protective measures. Rust-resistant varieties of plants should be evolved by hybridization and selection. Affected parts should be cut away and burnt. Very badly affected plants are best destroyed by fire. The soil may need to be replaced or disinfected if same kinds of plants are to be grown again. Rusts are more common in temperate than in tropical regions and may be controlled by Bordeaux-mixture sprayed preventively.

Stem-rot ; Root-rot ; Fruit-rot : Rotting of roots, stem, and fruits, in same kinds of plants as Carnations, Violets, Apples, Tomatoes, etc., is caused by attacks of fungi. Over-watering, want of drainage, and heavy texture of the soil are often contributing causes of rot. Soils infected with root and stem-rot should be disinfected by digging in lime. Infected roots, stems and fruit, should be burnt to prevent the spread of the disease during coming seasons.

If the soil is wet during any length of time, the bark of some trees, such as the Apple, Orange, Lime, Lemon etc., is susceptible to rot at the junction of the soil with the stem, as a result of which the trees perish. This "collar rot" is prevented by encircling the stem of the tree from the part wherefrom the roots spread to well above the ground level with a special pot, known as "collar pot" and watering the plants outside the pot only, so that the moisture does not come in contact with the stem. A collar pot consists of two semi-circular halves without a bottom, which brought together

round the stem forms a cylinder. In the absence of a collar pot, the next best course is to surround the stem with a small mound of soil leaving a space of 7.5 cm. to 15 cms. next to the stem which is filled with coarse sand. This would keep water away from the stem during irrigation or effectively drain away soon, even if it should reach the stem.

Fruits susceptible to rots, as apples and tomatoes, etc., can in a way be protected from severe attacks of the fungus rot by preventive spraying with Bordeaux mixture, after the fruits are set and before they become large and ripen.

Wilt: Wilt is a root disease common in Tomato, Brinjal, Carnation, Antirrhinum, Tobacco, Violet, and several other herbaceous plants, as a result of which they droop suddenly, as if for want of water and do not recover at all. Root affections in trees and shrubs become evident by the leaves dying and falling and the branches dying back. It is impossible to cure root diseases of this kind. Loss of other similar plants nearby may to some extent be prevented by removing the roots of dead plants and burning them and opening up the soil and treating it with quick lime liberally. It is forked into the soil lightly in the case of herbaceous plants and dug into greater depths in the case of larger plants. About 22 kg. of quick lime may be required for treating the area of soil covered by a large tree. 1.3 to 2.7 kg. will suffice for a medium to a large shrub. It is not advisable to grow similar plants in the soil for several years, as the disease is likely to recur.

"Damping off" disease: Young seedlings often rot at the surface of the ground and fall over and wilt, when they are known to "damp off". This is caused by particular fungi in the soil. Too thick sowing of seeds resulting in overcrowding of seedlings, excessive moisture in the soil due to too frequent watering or want of drainage, insufficiency of light and ventilation are the chief conditions conducive to the disease and therefore to be avoided. Sprinkling of sharp sand or charcoal powder over the surface of the soil may prevent the attack.

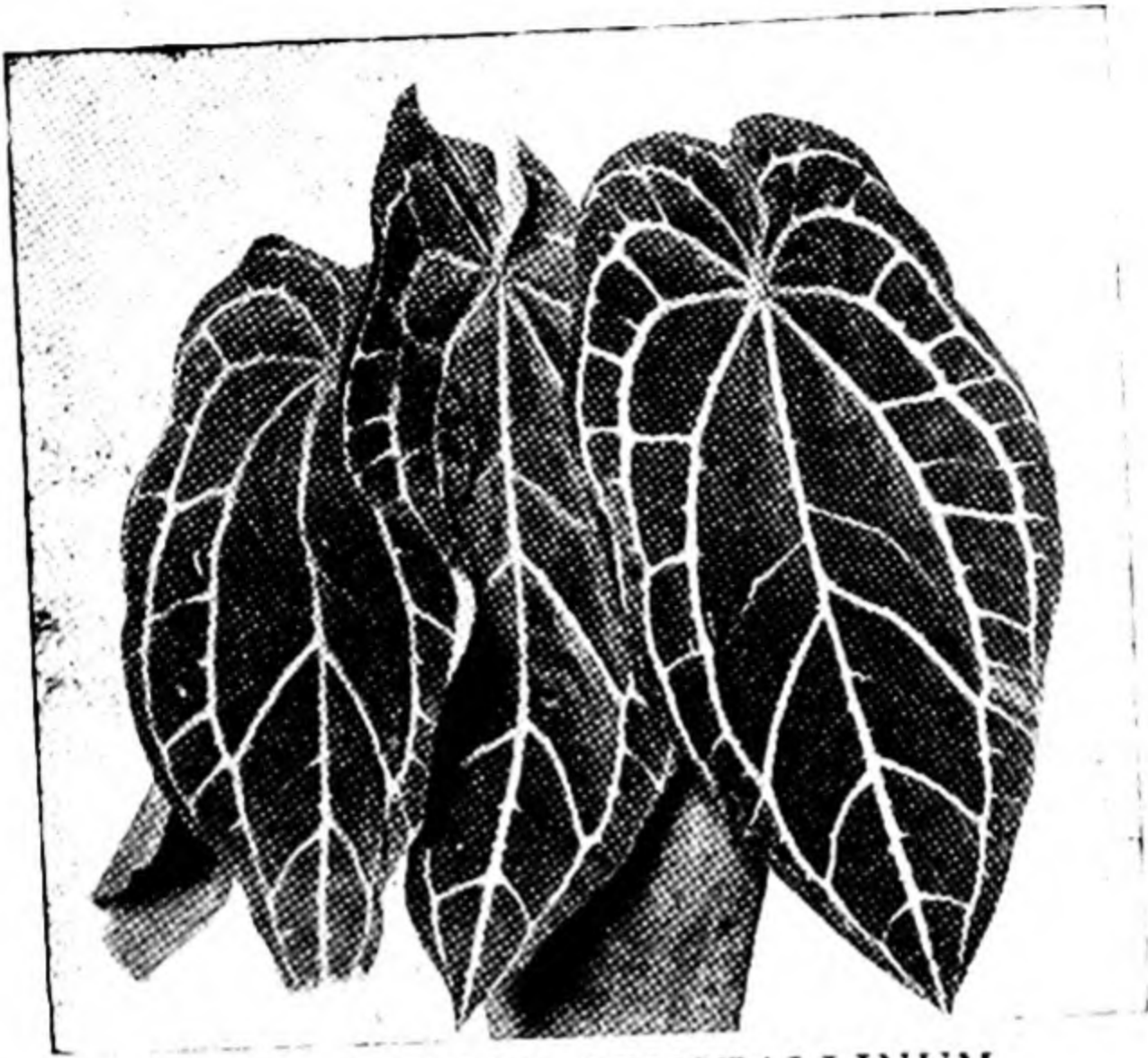
Sterilization of soil renders it safe against the attacks of this disease. Sterilization is effected by burning brushwood

on the surface of the seed bed, the resulting heat killing all weed seeds and fungi within its reach or by heating the soil in a broad iron basin over a slow fire for a short time, in case seeds are to be sown in seed-pans or boxes. Sterilization is also effected by drenching the soil with a dilute solution of formalin (one part of formalin dissolved in 50 parts of water and 2 to 4.5 litres of the solution being used for 30 cms. square of soil) and covering the soil with old gunny for 24 hours. Sowing is done 10 days later.

If damping off has already started, spraying the surface of soil with Bordeaux mixture or moistening the soil with "*Cheshunt compound*" checks the spread of the disease. Cheshunt compound is made as follows:— 2 parts of powdered copper sulphate and 11 parts of freshly powdered ammonium carbonate are mixed in correct proportions and kept tightly stoppered in a glass or earthen vessel for at least 24 hours. For use, 28 grams of the mixture is dissolved in every four gallons of water and the bright blue solution so obtained is applied wetting the soil thoroughly. Potassium permanganate solution (28 grams in 18 litres of water) and copper sulphate (58 grams in 4.5 litres) are also useful as soil sterilizers.

Galls : Crown gall : This causes rounded fleshy or woody tumors on roots and sometimes on parts above the ground also, usually starting from wounds and growing at the edges every year, very often girdling or causing the tree to break off. Galls may be expected in stunted orchard trees, whose crown and main roots should be examined periodically. Badly infected trees are best pulled out and replaced with fresh ones using fresh soil. If the disease has not too far advanced, it is controlled easily by chiselling out the galls and removing all unhealthy tissue up to the healthy portions of bark and sound wood, by sterilizing with solution of mercuric chloride, and then covering the wounds with Bordeaux-paste. Galls on large parts of the stem are similarly treated. Infected twigs and smaller branches may be removed and burnt.

Leaf Spot : Leaf spots appear in brown or black patches, with irregular margins increasing in size, the area surrounding the patches assuming a pale yellow colour. Defoliation takes place, which often weakens and kills the plant. This disease



ANTHURIUM CRYSTALLINUM



COLEUS



ALOCASIA MACRORRHIZA VARIEGATA



AGLAONEMA

is commonly noticed in Roses and Chrysanthemums. Affected leaves should be removed from the plant and burnt. Thereafter, the plant should be sprayed with Bordeaux-mixture. Addition of potash to the soil lessens tendency to this disease.

Witches' Broom or Stag head : This disease is caused by a parasitic fungus entering injuries caused by worms and grubs at the ends of shoots and producing swollen twigs in bunches resembling brooms and resulting in cessation of growth. The pest-infected growths should be pruned away, the prunings burnt, and the plant sprayed with Bordeaux-mixture.

Canker : This disease shows itself on leaves, fruits and young shoots, as yellow scabby or corky growths and swollen parts. Remedy consists in collecting all prunings, diseased leaves and fruits and burning them and spraying the entire plant with Bordeaux-mixture once every two months.

Sooty mould : Sooty mould occurs as a black thin crust covering the leaves, young stems and often blackening the fruits too, of particular kinds of trees and plants, such as the Orange Family, Mango, Sapota, Guava, which are attacked by sucking insects, especially the scale insects, represented by the Green Bug. The mould is a saprophytic fungus growing upon the excreta cast by the insects feeding upon the tender green shoots and leaves. The mould is only of superficial growth and does not penetrate the plant tissues, but it is harmful, as it blocks the respiratory pores of the leaves preventing them from carrying on their respiratory and food manufacturing functions and thus considerably weakening the trees as a whole. As the insects are the cause for the mould, they should be got rid of first by spraying with fish-oil-rosin soap solution or any emulsion mentioned under insecticides. Two such sprays at an interval of 10 to 15 days followed by one or two sprays with hot water in which soft soap is dissolved will clear the mould from the affected parts. First, the mould may be softened by a gentle spray and then washed off with a forcible one.

One notices ants streaming up the affected trees and moving among the leaves and shoots. The bugs, after they have exhausted the sap from the parts infested by them cannot by themselves move up to fresher parts of the plant. The

ants are busy carrying the bugs to these parts and depositing them there and thus helping them to thrive. In their turn, the ants are benefitted by feeding on the "honey" excreted by the bugs. So, in treating for sooty mould, the ants must be prevented from going up the trees by suitable sticky bands round the stem or destroyed.

Miscellaneous diseases : The causes of certain diseases as 'little leaf', 'die-back', 'mottled leaf', 'Rosette', etc., are not definitely known. They are known as physiological diseases and they show a marked relation to soil conditions and occur more especially in dry, sandy, or gravelly or 'hard-pan' soils, which are deficient in humus. These diseases appear under conditions of irregular moisture also. It is not worth while attempting to grow kinds of plants which are known to be susceptible to such diseases in particular localities or soils.

Gummosis : Exudation of gum from roots and stems of plants is known as gummosis. It weakens the trees and sometimes kills them. It may be brought on by several causes as unsuitable soil, poor condition of soil, excess or lack of water, sun-scald, wind-scald, and attacks of parasites. Badly gummed twigs should be collected and burnt. Diseased areas of bark should be carefully cut out and the wounds treated with Bordeaux-paste. Gummosis and die-back are very common in Citrus plants.

Chlorosis : Pale condition of foliage is caused by absence or deficiency of chlorophyll, the green colouring matter in the leaves. As iron is necessary for the formation of chlorophyll, deficiency of iron is very often the cause of chlorosis. Ferrous sulphate stirred into the soil at the rate of 20 grams per sq. metre attended with markedly good results. Leaves become yellow also due to root affections, due to disease, and grubs, wireworms and such other root feeding insects. Deficiency of copper and zinc in the soil is reported to be responsible for chlorosis in citrus trees. Sprays with Bordeaux-mixture or zinc sulphate in small concentrations up to 5% solutions will do good in some cases.

Die-back : As the name indicates, the branches and stem of affected trees and plants die-back, top downwards, as the disease progresses. Die-back may be due to injuries to

roots by fungus, or insects or careless root pruning, bad drainage, shortage of essential food elements, injuries to stem and branches by borers, gummosis, etc. All dead parts are cut off below the points they have dried and burnt. Portions of stem dead are scraped away and painted with Bordeaux-paste. Then, the cause for the disease is investigated and the disease treated accordingly.

Standard Fungicides : A fungicide is any substance that is used to kill fungi and their spores. It is usually a sulphur or a copper compound. Lime also is often used as a fungicide. Any fungicide used should satisfy two conditions. It should be effective against the parasite. It should not injure the plant in any way. Fungicides in the form of powder are best applied with the help of powder-blowers. They consist of a receptacle for holding the fine powder from which it is expelled in the form of dusty particles by pressing a bulb or moving a handle as in bellows. In the absence of any of the above accessories, the powder may be put in thin cloth bags and shaken over the plants. Liquid fungicides are applied with the help of a hand syringe, or a bucket sprayer, a knap-sac sprayer, or a barrel-sprayer, the size of instrument used depending upon the number and size of the plants to be sprayed. The efficiency of spraying depends upon the nozzle of the machine which should discharge the liquid in a fine mist so that it floats in the air in a cloud and settles on every part of the plant. Nozzles which squirt heavily are no good at all. The use of a fungicide may be protective against infection or remedial, when fungus growths are directly attacked. The more important use is the former one. Timely and thorough application of fungicides will check the spread of disease, though the injury already done cannot be repaired.

Bordeaux-mixture : It is the best fungicide discovered for plant diseases caused by fungus. It is made by mixing a solution of blue vitriol (copper sulphate) with milk of lime. The mixture should be used soon after it is made, as it is only then the gelatinous precipitate that is formed adheres to the surface of the leaves for a long time. If allowed to stand over for three or four hours, the mixture loses much of its adhesive property. It is prepared in the following manner :—

Dissolve in a wooden tub (iron containers are corroded by blue vitriol) 3 kg. of copper sulphate crystals in enough hot water and make up to 180 litres. In another vessel, slake 3 kg. of quick lime, by adding enough water to cover it. After slaking, add 45 litres of water. Strain the milk of lime through a wire strainer. Pour the copper sulphate solution slowly into the milk of lime, stirring the mixture thoroughly. The solution is ready for use. 5-5-50 is the formula, which is easily remembered. For making 250 litres of mixture, 3 kg. of blue vitriol and 3 kg. of lime are used. If the mixture is made from copper sulphate crystals and lime of best quality, a test for excess of copper sulphate or lime may be unnecessary. Excess of copper sulphate is injurious as it produces burning of foliage. Excess of lime makes the mixture less efficient as a fungicide. If lime is deficient, a clean knife blade or an iron nail dipped in the mixture for a few minutes will be coated with a deposit of copper, in which case, more lime solution is added to the mixture. Litmus paper will also give an idea of the acidity (due to excess of copper sulphate) or alkalinity (excess of lime) in the mixture. There is no danger if it is slightly alkaline. It should not be acidic. To enable the mixture to stick better, 1 to $1\frac{1}{2}$ kg. of common treacle might be added. Calcium caseinate, $\frac{1}{2}$ kg. in 250 litres of water, is useful, when added to the mixture to make it spread more evenly and adhere better. The following also makes a good and reliable adhesive mixture which will prevent in a large measure, the Bordeaux-mixture from being washed away by heavy rains, when added to it. $\frac{1}{2}$ kg. of washing soda is dissolved in 5 litres of water and boiled. 1 kg. of powdered rosin are added and the boiling continued for about an hour, stirring continuously. The resulting liquid will suffice for about 150 litres of Bordeaux-mixture.

Brands of Bordeaux-mixture or copper compounds are put on the market, which are ready for use after dissolving in water.

Burgundy-mixture is a fungicide similar in action to but costlier and easier to prepare and keep than Bordeaux-mixture. It does not clog the sprayer, which the latter does at times. For making 250 litres, substitute ordinary washing soda

(crystallised sodium carbonate) for lime in the mixture, using $1\frac{1}{4}$ times the quantity, that is, 3 kg. Excess of sodium carbonate or of copper sulphate is injurious to foliage. Red litmus paper dipped in the mixture and turning blue, indicates excess of soda. Blue litmus turning red indicates excess of copper. The required solution, either soda or copper sulphate, is added to the mixture to make it neutral in reaction to litmus.

Cuprammonium Wash : The deposit left by Bordeaux-mixture on the sprayed plants make them unsightly and to avoid this, the above wash is preferred by some. For this, liquid ammonia is added to Burgundy-mixture till the precipitate formed is dissolved. The wash is also formed by dissolving commercial copper carbonate in ammonia as follows. 1.5 litres of strong ammonia is dissolved in 5 litres of water. Copper carbonate is made into a paste with some water and this is slowly added to the ammonia solution, stirring well all the time. Remaining water to make 200 litres is added and the solution used fresh.

Lime-sulphur solution : Is now available in standard brands. It is effective against mildew, leaf-curl and many fungus pests and against scale insects. It is a valuable spray for application during the resting period of plants. It is made as follows :—Slake 2 kg. of fresh lime in an earthen vessel. Stir in gradually 4 kg. of fine sulphur, using enough water to prevent burning. Allow to boil for about 15 minutes by the heat of lime. Then add more water and boil for some time. Dilute to 250 litres and apply. Unless the solution is weak, it burns the foliage.

Lime sulphur solution mixed with lead arsenate makes an useful combined fungicide and insecticide.

Lime sulphur is preferred to Bordeaux-mixture where the effect of the latter is to protect the scale insects infesting plants, as in citrus plants.

Potassium sulphide : For powdery mildews, a solution of this substance is effective. For general use, strength of the solution recommended is 30 grams in 15 litres of water. This strength may be varied according to the nature and hardness of the plant.

Potassium permanganate : The following notes taken

from the *Journal of the Royal Horticultural Society* on the uses of this substance will be found useful. It is a strong oxidizing agent. Its solution in water which is known as Condyl's Fluid is effective as a spray against surface mycelium and some fungus spores. A 3% solution is good for mildew in Sweet Peas. A 5% solution is effective against anthracnose. 30 grams of the dark crystals is dissolved in 2 litres of water to make an 1% solution. 60 grams of soft soap dissolved in the above quantity of solution will enable it to wet better the sprayed surfaces.

Experiments at Wisely have demonstrated the following other uses of Condyl's Fluid in the garden :—

(1) For making compost. Small quantities of permanganate of potash hasten decomposition of garden refuse. One meter of refuse is soaked with 30 litres of solution containing 90 grams of permanganate. A month later, the refuse is turned over and again soaked with a solution of 90 grams in 15 litres of water and again a fortnight later with a solution of 60 grams in 10 litres of water. The heap will be ready for use in about 3 months.

(2) Stimulation of lawn grass growth. 30 grams in 10 litres of water applied over 3 metres of lawn,

(3) *Destruction of moss on lawns in hill stations* : 30 grams to 5 litres of water per sq. meter applied twice under dry conditions, at intervals of a fortnight, will cure worst conditions.

(4) Matted grass on lawns is eliminated by treatment similar to the above.

(5) Earthworms which are found to be a pest on lawns throwing up unsightly casts on lawns are brought to the surface by applying 30 grams in 5 liters per sq. metre.

(6) Plant growth is greatly helped by weak solutions of potassium permanganate.

Corrosive sublimate : Mercuric chloride, 30 grams in 50 litres of water, is useful as a good antiseptic wash for cut wounds on plants. Poured over the soil, it prevents root maggots, as on Cabbage roots. Uncut seed potatoes may be soaked in the solution for about half an hour before planting, to prevent diseases. Metal vessels must not be used to store the substance.

Sulphur powder : The fungicidal properties of sulphur are due to the fumes given off under the influence of the heat of the sun. Sulphur dust by itself or mixed half and half with quick lime dust is best applied in the early stages of the development of the fungus. The material is applied in the morning with a dry spray machine or powder blower or dusted through a thin muslin bag, on the foliage when it is still wet with dew. - It is well known remedy against mildew of several kinds.

Lime : Lime is used as a disinfectant of the soil, in club-root of Cabbage and such other diseases in the soil. Quick lime is powdered and incorporated into the soil and the land left fallow for a period of about 4 months.

Bordeaux-paste : Prepared only for the day's use by dissolving separately blue vitriol (copper sulphate) 5 kg. in 35 litres of water and quick lime, 12 kg. in 35 litres of water, and mixing them.

Seeds how disinfected : The seeds suspected to be collected from diseased plants are soaked for 15 to 20 minutes in 1% copper sulphate solution containing 30 grams per 5 litres of water, and then washed and dried or sown. Formalin 1 part in 400 parts of water, may also be used, the seeds being soaked in it for 2 to 3 hours and then sown immediately. Copper carbonate dust, a teaspoonful mixed with about 1.5 kg. of seeds for a few hours is attended with good results.

(N.B.—Copper sulphate and other Copper compounds and Corrossive sublimate are poisons which should be kept out of reach of children and pets. They should be suitably labelled and kept inside cupboards.)

CONTROL OF INSECT PESTS

Causes for outbreak of insect pests : Great many are the insect enemies of plants, and they exhibit striking peculiarities in form, size, colour, structure and habits, and methods of transformation. Though an active warfare has been carried on by man against destructive insects, they have not appreciably decreased. On the other hand, they seem to be frightfully on the increase. The economy of their nature is

extremely favourable for their reproduction on an immense scale. The ignorance of the layman in respect of their life history is so great that he is helpless in his struggle against their ravages. Efficient means for the destruction of insects can only be devised if one knows their nature and habits.

It is not every insect that the gardener comes across that is harmful to his plants. There are a good many insect garden friends, as the honey-bee and the lady-bird beetle. They are helpful either to fertilise his flowers for formation of fruits and seeds, or are helpful to prey upon insects which attack the plants. The outbreak of insects is due to several causes. Deforestation increases pests by upsetting the balance of life in relation to the parasite and the host plants; so also indiscriminate shooting of insectivorous birds. Proper want of rotation of crops and the introduction of new varieties of plants, vegetables and fruits with the insects that damage them but not with the natural enemies of these insects, are also responsible for the increase of insects.

Insects : Insects are living beings which have a jointed body consisting of three principal divisions; (a) the head with the *antennae* (the feelers), and the *mandibles* (the biting lips), or the *proboscis* (the sucking apparatus) (b) the thorax and (c) the abdomen. Insects breathe not through lungs but through the tracheae, which are long tubes running through their body and limbs. Some insects as beetles bite and chew their food like higher animals, their jaws or mandibles moving horizontally. These are known as "chewing insects." Examples of these are caterpillars, grubs, beetles, grass hoppers, snails, crickets. Others puncture the tissues of the epidermis like the mosquito and suck plant juices from inside through a tube or proboscis. These are known as "sucking insects." Examples of these are the green bug, aphid, thrip.

The life history of insects : Insects pass through a series of changes in their life history. Most of them pass through four distinct phases of existence, which are :—(1) the egg stage (2) the larval stage. The larvae emerge out of the eggs laid by adults, either beetles or moths, and the larvae are known differently as grubs, borers, caterpillars, worms, maggots, etc. Larvae are voracious feeders on roots, foliage, flowers,

and fruits. Most kinds are fantastically marked with a variety of colours, while many assume the colour of the young shoots or flower on which they feed, thus eluding notice. They can be found only after diligent search. Their presence is indicated by the damage done and the droppings on the leaves and on the ground. (3) The pupal stage. The larvae after a destructive course of living, build cocoons round their bodies and go to rest. (4) The adult stage. The larvae transform themselves into winged beetles, butterflies, flies, or moths and emerge out of the cocoons. Their chief occupation is to lay eggs. But certain kinds among them, as rose beetles, are very destructive on foliage, tender stems and flower buds.

Methods adopted for controlling pests: Remedies for control of insect pests fall under five heads :—(1) Legislative, by which the Government prevents the import of plants infested with insects, which, if introduced into this country, would become local pests. (2) Parasitical and Biological, by introduction of another insect as parasite, as for instance encouraging Lady Bird Beetles, and certain Flies which act as parasites and kill other insects as aphids, caterpillars, bugs etc. Frogs and toads, garden lizards, mongoose, wasps, and some birds are very useful in putting down insects. (3) Cultural. (4) Mechanical and (5) Chemical or Insecticidal.

The grower should have his eyes on his plants and foresee when and how insects attack the different kinds of plants and take suitable measures to overcome them.

Cultural methods of controlling insect pests: Good cultivation destroys the hiding places of insects and removes weeds and wild plants which often act as host plants for insects from which they multiply and spread to garden plants.

Proper rotation of crops helps much to keep down the increase of insect pests attacking particular plants.

Plants maintained in a vigorous and healthy growth by feeding them with suitable manures, and watering regularly, are better able to resist attacks of insect and fungus pests.

Mechanical methods of controlling insect pests: Removal of egg clusters, such as those on Citrus leaves and insects which feed gregariously as caterpillars, and destroying them is a desirable method of controlling pests.

Hand-picking of insects, like beetles, is efficacious, if resorted to on the first appearance of the pest, when its numbers are still small. They are dropped into a basin or vessel containing water with a film of oil, preferably kerosene, floating on top. The more active insects as grass-hoppers may be caught with the help of a simple hand-net, by sweeping it over the plant. Such a net can be easily made by tying a bag of thin cloth or net to a loop of split bamboo or cane, which is fixed on to the arms of a Y shaped branch, of which the main stem forms the handle of the net.

Several adult insects as moths and beetles are blinded by light and caught with the help of light-traps. If only a few, a light can be taken near the plant and the insects picked. If there are too many of them, an ordinary lamp may be suspended over a basin of water with a film of kerosene floating on the surface and kept burning throughout the night near the plants attacked. The insects are attracted by the light, dash against it, and fall into the water. On still, warm nights large numbers of insects can be killed in this manner. Fires kindled near the plants will also attract insects which would be destroyed. Smoke scares away insects and a light smoky fire near by or under Mango trees is helpful in destroying or scaring away hoppers.

Branches and shoots attacked by borers, should be cut away, if small, and burnt, to prevent the insects from coming out and attacking other plants.

Burning with a small torch may be resorted to in the case of such insects as caterpillars, which gather gregariously forming large patches on tree trunks.

Banding the base of the stem with a sticky tape or cloth dipped in melted wax or in a mixture of tar and crude oil emulsion in equal proportions, prevents many insects as ants, etc., from getting access to trees and shrubs.

CHEMICAL OR INSECTICIDAL METHODS OF CONTROLLING INSECT PESTS

Insecticidal methods should be employed when the cheaper commonsense mechanical methods fail and when insects have

attained such numbers as to form a pest. Insecticides are substances which are used to kill insects. They are some times used as repellents also. Insecticides may be solids, liquids, gases or vapours. They are usually classified under three heads :—(a) Stomach poisons. (b) Contact poisons, and (c) Gaseous poisons.

Stomach poisons are used for destroying insects like beetles, grass-hoppers, grubs, caterpillars, leaf-rollers, etc., which chew and tear off bits of plants, which they pass into the alimentary canal for digestion. Sucking insects as bugs, aphids, etc., cannot be killed by spraying stomach poisons on the plant, as the poison is not taken by them into the stomach. Nor can the plants be injected with poisons to kill these. So, contact poisons, which block the respiratory pores of the insects suffocating them to death, or which cause their death by irritation to their body, are used in the case of sucking insects. Some sucking insects have too hard a coating, against which contact poison is not of much use. Gaseous poisons are used to destroy them. A deadly gas like hydrocyanic gas is evolved in a closed atmosphere and the plants attacked with the insects are placed therein to be gas-poisoned. This method is too dangerous to be employed in private gardens. Nowadays, what are called soil fumigants are used against such pests as white ants, wire worms, and other underground insects.

Application of insecticides: Solid insecticides are “dusted” on the parts affected, in the form of a fine powder, through a thin muslin bag or powder sprayer or bellows. Liquid insecticides are applied in the same manner as liquid fungicides. “Fumigation” is the term applied for using gas evolving insecticides. The method known as “trapping” or “baiting” is adopted in the case of certain insects when food materials are mixed with poisons and placed in their haunts.

Some remarks are necessary in connection with the use of insecticides in general. The insecticide should cause the least possible injury to the plant itself while it should be very efficient against the pest. The strength of the insecticide should be varied to suit the circumstances of each case. A stronger solution may be employed on cloudy days and on plants with mature foliage than that used on hot days and in connection

with tender foliage. Due regard should be had to prevailing weather conditions. It might be useless to waste insecticides on rainy days, when they would be washed away. Insecticides should be used early in the morning or late in the evening. The foliage is injured if they are applied during the hot hours of the day. The substance should be washed off by spraying with clear water after it has effected its purpose.

SOME WELL-TRIED INSECTICIDES

Stomach Poisons

Lead arsenate : Available in the form of a paste, containing about 50% by weight of water or white powder. It is produced as a precipitate by mixing solutions of 30 grams of arsenate of soda in 15 litres of water and of 60 grams of lead acetate in a like quantity of water. Lead arsenate is a safe and effective stomach poison, used against chewing insects as beetles and caterpillars. It is harmless to foliage, even if the strength used is stronger than the one recommended. It is best sprayed upon plants in a state of colloidal suspension in water. 30 grams of paste or 20 grams of powder may be used for 25 litres of spraying solution. Its efficacy is increased by adding to it 30 grams of lime and 60 grams of molasses. As a dry powder to be dusted on affected plants, it is best mixed with a neutral powder as powdered lime, wood ashes or road dust in the proportion of $\frac{1}{2}$ kg. of arsenate to $7\frac{1}{2}$ kg. of the other powder.

Arsenate of lime : A cheaper substitute for lead arsenate. Sold as such and can be made easily too by dissolving $\frac{1}{2}$ kg. arsenic and 1 kg. washing soda in 10 litres of water; to $\frac{1}{2}$ litre of this mixture are added 20 litres of water and 60 grams of unslaked lime. This substance is not quite so safe as Lead arsenate for use, as it causes burning of foliage. It is more useful as a dust than as a spray.

Paris Green (aceto-arsenite of copper) : A green powder and a violent poison, not so safe as lead arsenate as it may cause burning of foliage. For dusting, is mixed with 6 times its volume of lime. For spraying, 30 grams of powder is made into a thin paste with a little water and mixed with 30 to

40 litres of water and stirred thoroughly. The strength of the mixture is regulated according to the nature of the plants.

N.B.—The above are three insecticides are poisonous to man and animals.

The following are two vegetable insecticides, valuable both as stomach and contact poisons and not dangerous to man and domestic animals and therefore of immense value for use on vegetables and fruits :—

Derris : Several brands of Derris are available. 90 to 120 grams of powder dissolved in 50 litres of water which $\frac{1}{4}$ to $\frac{1}{2}$ kg. of soft soap is dissolved and used as spray.

Pyrethrum : Also available in the market, in several patented names. 30 grams of powder soaked in 5 litres of water for 24 hours and the solution used as spray.

Poison baits

Ant poison : Prepared thus :—10 grains of arsenate of soda and $\frac{1}{2}$ kg. of sugar are boiled and dissolved in a quart of water. Then, a tablespoonful of honey is added. When cool, the substance is placed in shallow dishes with crusts of bread or bits of sponge, on tasting which, ants which are attracted in large numbers die.

Poisoned bran mash : $2\frac{1}{2}$ kg. of wheat bran, $\frac{1}{2}$ litre of cheap molasses, 120 grams of white arsenic, lemon juice of one fruit, and 4 litres of water are mixed to form a dry mash and scattered around the field to cut worms, army worms, grass hoppers, etc. $\frac{1}{2}$ kg. of Paris Green mixed with 10 to 12 kg. of bran and a small quantity of water also makes a good bait.

Contact Poisons

Fish-oil-rosin-soap : A ready-made dark brown, semi-solid substance which is dissolved in water before use. Sprayed on plants, as a remedy against all kinds of sucking insects such as plant lice, mealy and other bugs, scales and mango hoppers. Usual dose for soft bodied insects is $\frac{1}{2}$ kg. of soap to 35 litres of water. 1 kg. of soap may be used for hard covered insects. The spraying should be persistently done, a third or even a fourth time, to kill young insects recently hatched from eggs, on which the first and second sprayings might be ineffective.

Honge-oil-rosin soap : This soap is prepared from

pongamia oil instead of fish oil and is quite as effective on insects as the above soap.

Rosin-compound : Useful for controlling obstinate scale insects. Used and made as follows : 2 kg. of rosin and $1\frac{1}{2}$ kg. of washing soda are dissolved by boiling 5 litres of water. While boiling more water is added slowly to make up the mixture to 25 litres. This is the stock solution. 1 part of this is mixed with 5 parts of water for spraying.

Crude-oil emulsion : Sold in tins and drums. Used for spraying, diluted with water, against obstinate scale insects. It should not be allowed to run down trunks of trees and collect below. To avoid this, a layer of earth is spread on the ground under the tree, and this is removed later. Useful for green bugs and scales on Citrus trees.

Kerosene emulsion : One of the oldest known contact insecticides. Readily made when wanted. $\frac{1}{2}$ kg. of common soap is dissolved in 5 litres of water. The solution is boiled for dissolving the soap well. After removing the vessel from the fire, 10 litres of kerosene oil are added to the solution and the whole mixture is churned or violently agitated by being worked upon itself by a force pump. This is done till the whole quantity of oil is emulsified. This strong emulsion is diluted with 10 to 15 times water before use. 30 grams of glue may be added to the mixture to enable it to stick better. Kerosene emulsion is in disfavour, because, if the oil is not properly emulsified, it is very harmful to foliage.

Lime sulphur solution : Effectively used against scale insects. In combination with Bordeaux-mixture or lead arsenate, it acts as a combined insecticide and fungicide.

Soap solution : A solution of any bar soap or preferably soft soap, $\frac{1}{2}$ kg. dissolved in 30 litres of water acts as a cheap contact poison against soft bodied insects as plant lice, delicate larvæ.

Tobacco decoction : Tobacco and its products are some of the best known insecticides. It may be cumbersome to prepare tobacco solution. Several nicotine preparations, such as nicotine sulphate, are available, which can be used readily. The commercial preparation is usually a 40% extract requiring dilution before use. 30 grams of it is diluted with 25 litres of

water spraying. It kills both by contact and by gas evolved. Tobacco decoction is made as follows :— $\frac{1}{2}$ kg. of tobacco stems and leaves is boiled in 5 litres of water for about half an hour or it may be steeped in cold water for a day or two. In this decoction, about 120 grams of soap is dissolved. When cool, it is diluted with 5 to 6 times of water and sprayed upon plants infested with plant lice, mealy bugs and soft bodied insects.

Methylated spirit : Very effectively used with a Flit sprayer or painted over parts infested with mealy bugs.

REPELLANTS

Preparations and substances used for keeping away insects are the following :—

Gondal Fluid : Prepared thus :—120 grams of gum, 240 grams of asafoetida, 240 grams of bazaar aloes, and 90 grams of castor cake are mixed well with boiling water ; clay is added to thicken. The resulting substance, when cool, is painted on the base of stems of trees, which are liable to be attacked with ants or other pests.

Quick lime : Spread on the ground in the form of powder, keeps away slugs and snails.

Wood ashes : Very often dusted upon plants like Brinjals to keep away insects.

Naphthalene emulsion : To make this, in 5 litres of kerosene placed in a vessel of warm water are dissolved $\frac{1}{2}$ kg. to 2 kg. of naphthalene powder. In another vessel, in 5 litres of water raised to almost boiling point are dissolved 1 kg. of soap and 30 grams of glue. The two solutions are mixed and stirred well and 3 litres more water added. The resulting solution may be effectively used by vegetable growers against biting insects.

SOIL FUMIGANTS

Are substances stirred into the ground for expelling and killing white ants, grubs, eelworms, millipedes, cockchafer

and other beetles etc. Several proprietary materials are available in the market.

Naphthalene : Crude naphthalene, $\frac{1}{2}$ kg. mixed with 4 kg. of lime. crushed fine and kept in a sealed vessel. 7 grams of the mixture stirred into a sq. meter when required.

Para-dichloro-benzene : A strong smelling white substance which vaporises more readily than naphthalene is preserved in stoppered or well corked bottles. 30 grams of the substance is mixed well with 1 kg. of fine leaf mould and a pinch of the mixture put into small holes made in the ground 20 cm. apart in infested areas and covered over with soil.

Carbon disulphide : An explosive, nasty smelling, volatile liquid. Balls of cotton dipped in it and dropped into holes, effectively kill ground vermin, such as termites. To prevent the vapour from escaping, the holes are sealed with moist clay. This substance is often used to fumigate insect-infested, stored agricultural products and seeds. 35 c.c. of the liquid may be necessary for every 12 cubic metres of space.

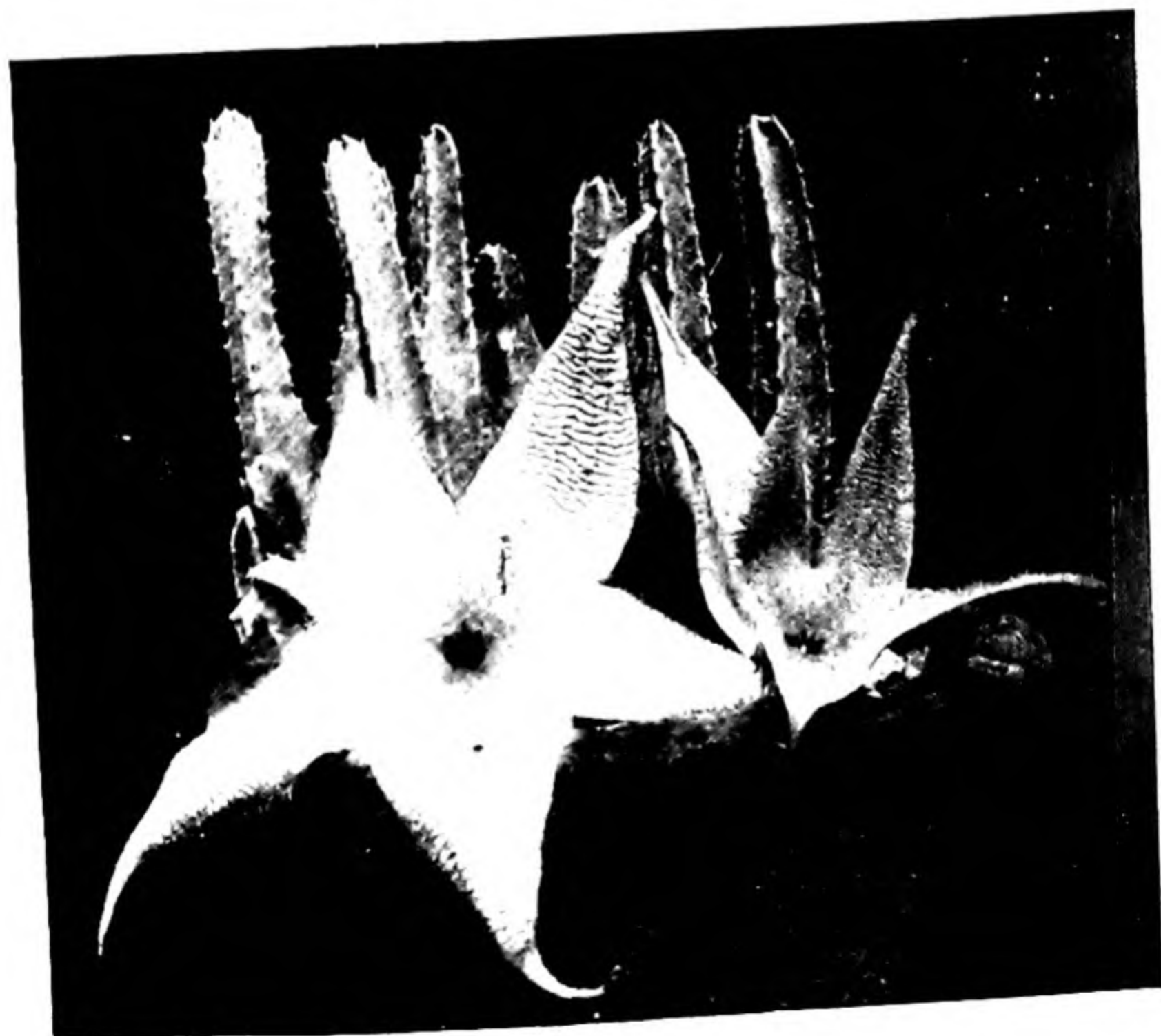
SOME COMMON INSECT PESTS

Caterpillar pests : Larvæ of different kinds of insects (moths, butterflies, beetles, weevils etc.) known as caterpillars, grubs, worms, maggots, borers attack foliage, flowers, fruits, tender shoots and stem, and sometimes roots. They are all voracious eaters causing great destruction. They are best handpicked at the first sign of their appearance, which is generally about the outbreak of the South West monsoon.

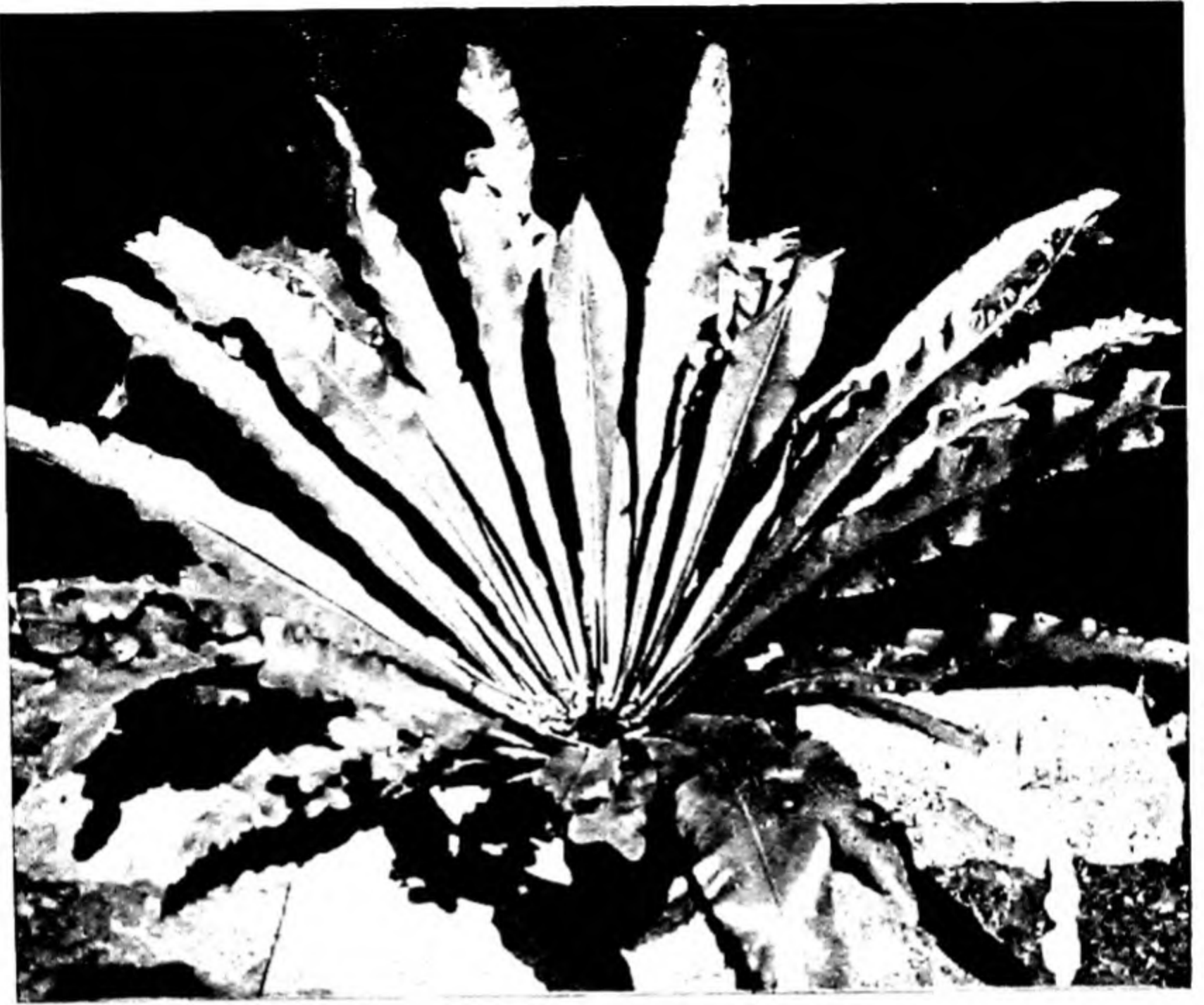
Caterpillars vary in size, colour, shape and are smooth or hairy. They work singly or in swarms, during day or night. According to their methods of attack, they may be classified as (1) *Leaf-eaters*, *Leaf-rollers*, *Leaf-miners*, which are well known pests of vegetables belonging to the Cabbage family, and some others. Should handpicking prove ineffective, spraying with a repellant as naphthalene emulsion or tobacco water would be helpful. A non-poisonous insecticide as derris may also be used with advantage against the worms. (2) *Swarming caterpillars* which appear in very large numbers and effect considerable damage. Where swarms are known



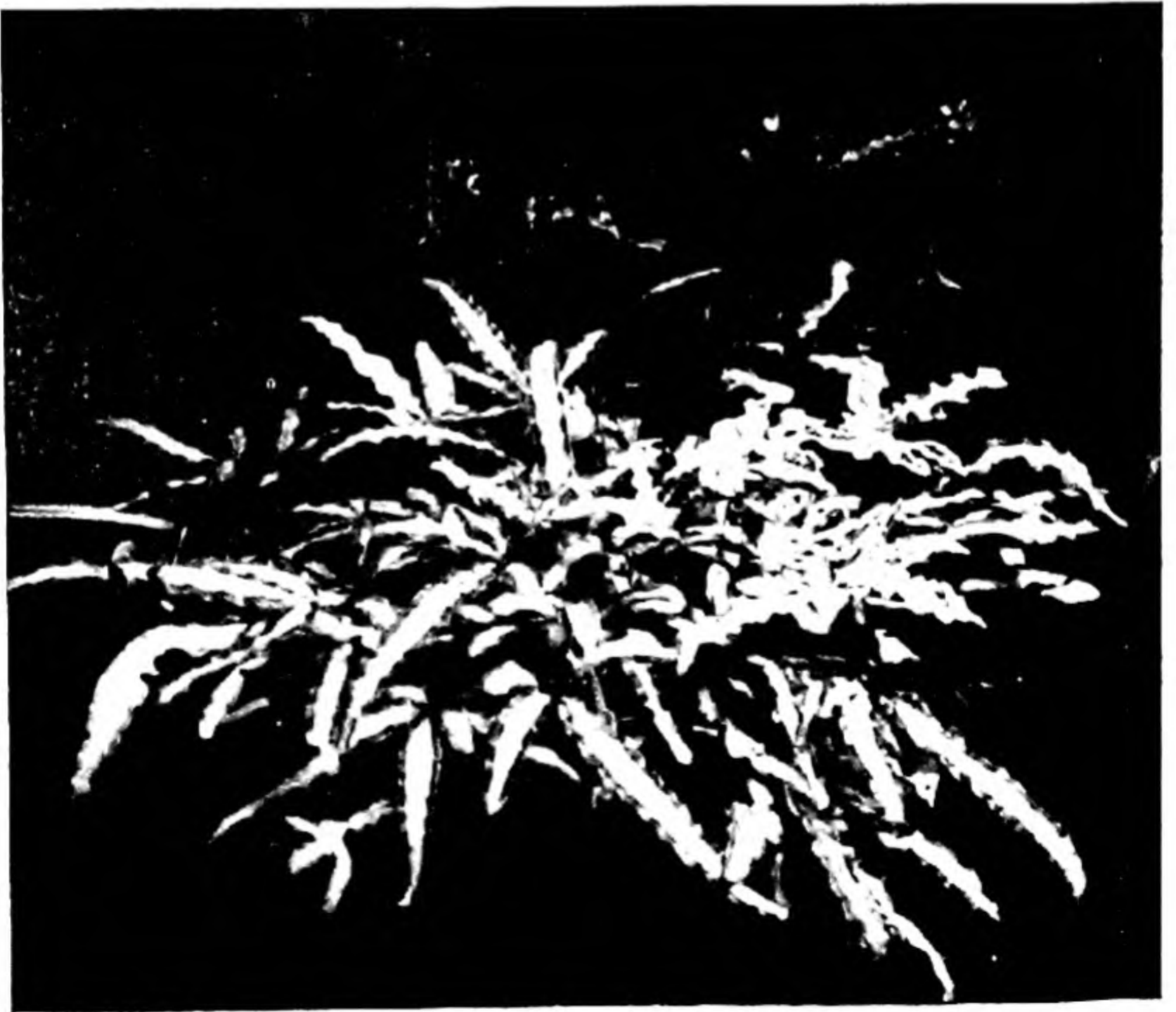
A COLLECTION OF COXYLEDONS
(Echeverias and sempervivums)



STAPELIA GRANDIFLORA



ASPLENIUM NIDUS AVIS



PTERIS CRETICA VARIETY ALBO LINEATA

and effect considerable damage. Where swarms are known to appear periodically, a trench dug round the garden, making it sufficiently deep with the sides sloping and smooth, is helpful to hold them in check. In the trench, they are destroyed by fire from a torch. Poison baits may be laid to attract them. (3) Surface caterpillars, which live and feed near the surface of the ground. Cutworms which bite through the stem and destroy plants belong to this class. The best method of controlling them is to spread some small heaps of finely cut up vegetable leaves which they prefer and collect them for destruction when they seek shelter in the heaps. Poison baits are also useful.

Beetle pests: The worst beetle pest in the garden is the *cockchafer*, both in the larva or grub stage and the adult of beetle stage. In both the stages, it is a voracious eater of roots, foliage and flowers. Lawns and plantations are known to be destroyed by grubs. Entire foliage of Rose plants is eaten in the course of two or three nights by the beetles. The grub has a large bloated body. It remains under the soil eating away roots of plants. It is a curse to pot plants, to the soil of which it gets introduced through the manure in the egg stage. The destructive work is carried by the larvae, when the eggs hatch, till the plant turns yellow in leaf, withers and dies. Handpicking is the best remedy. Paradichloro benzene is effective as a soil fumigant. The grubs transform into beetles which are brownish in colour and are found to be very active at night, when they come out of the soil from their hiding places, on leaves and flowers and fruits too. They are best caught with the help of a light at night and thrown into bottles containing water with some kerosene floating on it. If the attack is too severe for handpicking, lead arsenate sprayed upon the plants is effective in killing the beetles.

Beetles, generally: Other kinds of beetles too are killed by handpicking or lead arsenate. To mention some, leaf-eating beetles as Red Pumpkin beetles, Black Pumpkin beetles, the White weevil feeding on leaves of Cotton, brown or blue Flea beetles. The Pumpkin beetle feeds on the leaves of Cucumbers, Melons, Pumpkins etc., and is one of the worst pests in certain seasons. Dusting with tobacco dust and lime,

containing 1 part of the former with 5 parts of the latter, is helpful. These Pumpkin beetles should not be confused with the Lady Bird beetles which are beneficial to the gardener. The Lady Bird beetle is almost circular in shape and the Pumpkin beetle is elongated and rich orange yellow in colour. Epilachna beetles are those which attack Brinjal and Cucurbitaceous plants. The Blister beetles are of a dull brown colour or are banded black with variable bands of orange on the elytra. Hand-nets are useful in dealing with them as they appear in very large numbers attacking field crops, flowers and foliage of garden plants. As their excreta is acid and likely to blister the skin, the beetles are best shaken into a basin containing water to which kerosene is added. The Rhinoceros beetle is a large thickest black beetle over two inches long and an inch broad. It flies at nights attracted by lights. It feeds upon the soft tissues of Palms, attacking the unopened leaf or the base of the fruit-stem and eating into the soft heart of the plant. It is killed while at work by transfixing it with stout wire passed into the part of the plant where it is suspected to be active. The Rhinoceros beetle is dangerous because it attracts the Red weevil, which is a small beetle, which lays eggs in the holes made by it. The eggs hatch into larvae which devour the stem, killing a large palm in a few months. The best remedy against the latter is to cut down and burn badly infested trees.

Snails and Slugs: These are very destructive on young seedlings and plants and they lay bare many a flower bed. They lie hidden in the soil during the day and come out during night. They may be attracted to poisoned food in places frequented by them or picked by light at night. Application of soot and lime powder to the surface of the soil keeps them off. An application to soil infested with slugs, of ammonia water (30 grams of Liquor ammonia in 40 litres of water) is recommended.

Crickets are nocturnal in habit and destroy young stems and tender seedlings. They make small holes amidst powdery heaps of earth in lawns and flower beds about a foot apart. A tea spoonful of carbon disulphide put into the holes will kill or drive them out. Dilute solution of phenyl may also be

used to flood the hole.

Earthworms: They enter pots through drain holes, move through the soil disturbing and loosening the roots. They may be removed from the ball of earth and turned out of the pot with a pointed stick. Vapourite may be used to exterminate them.

Borers: Caterpillar borers, which are usually derived from moths do not bore down so deeply into stems of plants as beetle borers which are usually derived from beetles. The caterpillar borers are killed by punching them with wire or putting neem oil into the holes bored by them, with a fountainpen-filler. Beetle borers are killed by plugging the holes with cotton wool dipped in a mixture of two parts of chloroform and one of creosote, and sealing the outside with beeswax. The branches, bored by them, if too small, may be pruned and burnt.

Aphides (Plant Lice): They are small soft-bodied insects which gather in colonies on tender parts of plants like the shoots, tender foliage, buds, flowers, etc. They suck the sap from the plant, with the result that growth is checked and the affected part or plant gradually dries up. Plant lice are usually green, deep purple or black in colour and are commonly seen on country runner Beans, Beans, Cabbage, Radish, Citrus plants, Chrysanthemum, etc. Some species are winged and some are not. They multiply very rapidly and should be promptly dealt with. They do their work of destruction assisted by ants, by an interesting and peculiar relationship with them. The ants are attracted to the lice by their sweet excreta on which the ants feed, and in their turn, the ants help the lice in transporting them to fresher regions on the plant where they get fresh supplies of food by way of plant sap. Hence steps should be taken to destroy the ants also. Aphis are harmful in another way. On their excreta left on the foliage and parts of plant, the sooty mould fungus develops. Tobacco decoction, Fish-oil-Rosin soap, and sometimes mere soap water are used to get rid of plant lice. As aphis are numerous and overlies one another in masses, to reach all of them, a second and even a third application of the insecticide is often necessary.

Mealy and wooly bugs: These are serious enemies to several kinds of plants, infesting all parts as roots, branches, leaves, flowers and fruits. They often collect in compact colonies depositing eggs in masses of cottonlike fluffy material. The newly hatched insects are very small and yellowish in colour. They soon get covered with whitish powdery wax which extends as rods and tails all round the body, a characteristic which has given them the common name by which they are known. They are sucking insects like aphids, but they are not easily killed with soap water or tobacco decoction. Kerosene emulsion or some oil compound is necessary to get rid of them. Repeated application of an oil insecticide as Fish-oil-Rosin Soap or the Kerosene emulsion or Crude oil emulsion may be necessary to get rid of them. Methylated spirit either sprayed on the affected parts with a Flit pump or sponged with a rag kills the insects. Like the aphids and the scale insects, they also encourage ants and sooty mould.

Brown and Green Bugs and other Scale insects: These are different species of sucking insects with hard horny coats on their bodies which make it difficult for the gardener to eradicate them. Their hard coats prevent the action of contact insecticides on them, while stomach poisons are of no use. Repeated spraying with oil emulsions are to be tried. Against some scale insects, lime sulphur is effective. Fumigation is resorted to when other methods fail.

The San Jose Scale forms crusts on stems of Roses and other plants. The insect is circular in outline, is of the size of a pin head with a raised centre. Bordeaux-mixture is a good preventive against it. Lime sulphur is also effective. A paste of cow-dung, sulphur, and red earth in tar water is also useful, if applied on the affected parts of the stem.

Thrips: These are small six-legged insects living on the underside of leaves, sucking the sap out of them. Like aphids, they thrive in the dry season. Syringing plants and the surface of the ground with water does good. Soap solution containing tobacco decoction is effective.

Red Spider Mite: Red spiders are tiny suctorial mites, about 5 mm. long, ranging in colour from misty brown to brick red, spinning small webs over their breeding ground on

the underside of leaves. Like thrips, red spiders are formidable enemies of the garden causing entire defoliation of certain plants, as Crotons. Like thrips, also, they increase rapidly under dry conditions of weather and can be kept under control by frequent spraying with water. Nicotine solution is effective against the pest.

Ants : Ants not only encourage the increase of such insects as bugs, scales and aphids, but also are a nuisance by themselves, as they bite and injure tender stems of plants like the Dahlia Aster, Amaranthus, etc., and also remove seeds from seedpans and nurserybeds. They may be poisoned with the syrup mentioned earlier. They may also be attracted to bits of charred copra which may be dropped into kerosene when the ants have collected on them. To repel them from beds, 120 c.c. of kerosene may be added to 20 litres of warm tobacco decoction and the mixture freely used to water the beds. Ant hills should be destroyed by injecting into the holes 15 c.c. of carbon disulphide and closing them up with lumps of wet clay.

Termites (White Ants) : Termites are one of the most dreadful pests which a gardener has to contend against. There are several species, some attacking dead stems and some attacking living stems, killing plants in a short time. A good quantity of sand all round the stem helps to keep off white ants for some time. If the collar of the plant, that is, the basal portion of the stem which is in contact with the soil, is smeared over with lime sulphur solution, the white ants are kept a distance till the insecticide gets washed out. Gondal fluid is also helpful to keep away termites. Neem oil in which powdered paradichloro benzene is dissolved or stirred in is also effective. Ant-hills near the garden should be opened out and the queen ants killed. Four Oaks White Ant Exterminating Machine is very useful for fumigating ant hills with sulphur and arsenic fumes which kill the insects.

Other enemies of plants : Stray cattle are to be kept out by a suitable fence or barrier. Trees and shrubs should be provided, if need be, with guards. Hares and rabbits should be scared away by spreading twigs and brambles round beds and borders. They could be caught with nets. Rats and bandi-

coots which scoop out of soil, uprooting plants, should be destroyed by poison baits. Rat poisons are obtainable from the market. An effective rat-poison is made thus :—15 c.c. strychnine is added to 20 c.c. of sugar syrup. Rice or wheat grains are soaked in it for some time. They are taken out and placed in places frequented by rats. Crows and sparrows and some other birds are very troublesome, the former pecking at bulbous rooted plants and the latter eating away seedlings and removing seeds from seed pans and nurserybeds. Crows are usually kept away by shooting one and hanging it up near the desired place to scare away others. It may also be necessary to protect the plants with a sort of network made by strands of thread. Sparrows, bulbuls, and such other birds can only be scared away by nets. The twigs of trees and shrubs where such birds collect for resting at night may be here and there smeared with a sticky substance as jack fruit gum or bird lime. Bird lime is easily prepared thus :—A lump of rosin about the size of a hen's egg is added to 10 c.c. of linseed oil which is kept boiling. When the rosin is dissolved, a tablespoonful of treacle is added and the whole material stirred frequently while cooling.

CHAPTER XII

THE GARDEN AND ITS PARTS

The garden and its layout: A garden may be defined as an area embellished with plants, a valuable and pleasurable adjunct to a house. It affords light and pleasant recreation after a day's hard work and business cares, and is hence a necessity of modern life.

A garden is a work of art. A mere collection of plants will not make a garden. It is the skilful arrangements and disposition of plants over the area, making a design or pattern or picture as it were, that forms a garden. Gardening, then, necessitates not only the acquisition of an intimate knowledge of the science of plant growing but also requires artistic taste on the part of the gardener. He should acquaint himself fully with his plant material, with the habits of growth and nature of the several trees, shrubs and plants in order to enable him to allot suitable places for them in the garden design. He must think out and evolve a design which would give the maximum of pleasing effect, limited only by certain circumstances and conditions, the chief being the length of his purse.

In laying out a garden, several factors have to be taken into consideration, as for instance the taste and judgment of the owner, the position of the house in relation to the grounds, the size of the house, the extent of the grounds, the source of water supply, the shape and formation of the land, the labour available, the cost of making it and the ability of the owner to maintain it in condition. It is obvious, then, there cannot be any fixed design suited to all places. As in no two cases the above-mentioned factors would be the same, no two designs can be identical. Garden planning is thus very elastic in scope and it affords immense possibilities for variety of design.

In the history of garden-making, there have been two styles, the formal and the natural, each fancied and admired by its own advocates. They are diametrically opposed to each other in conception. The natural style, which is also called

the landscape style, aims at an intimation of Nature inside the garden and strives to produce a rural effect with large open lawns, uninterrupted as circumstances would permit, and bordered by clumps of shady trees and shrubs. This type of gardening is suited to a place on the country-side, where the villa is small and situated on one side of a wide extent of grounds and where Nature furnishes a rich luxuriance of scenery and vegetation in and beyond the grounds. In cities and towns, where such natural advantages are not available, it is futile to attempt to reproduce in a small compass Nature's wild and rugged effects.

The geometrical or formal or the symmetrical style, as it is differently called, is, as the name implies, entirely formal and is calculated to afford harmonies and contrasts in colour and a balanced whole, one half of the design being a counterpart of the other. Supposing such a garden to have a line drawn across its centre, the flower beds on either side would be similarly placed, similarly made, and filled with similar plants. There is thus a method, symmetry and attention to minute details in this style of gardening. It would harmonise with massive buildings with enormous frontage.

The style of gardening which combines the good points of both, the natural and symmetrical styles, and which is now most favoured in city gardens goes by the name of the picturesque or artistic or free style. It dispenses in great part with the formality and flatness of the geometrical style. It takes into consideration the essentials of the typical natural garden and displays great freedom in treatment. This free style is capable of being adapted to suit the needs of almost all situations and hence is deservedly popular. It makes full use of trees, shrubs, flowering and foliage plants, climbers, rocky places, streamlets and ponds, trelliswork and grass, and is of diverse features.

As landscape gardening has made a name for itself and is the ideal of many a large estate owner, the principles to be adhered to for effective landscape gardening may be mentioned here. These are ably discussed by Bailey in his *Book on Garden Making*. He lays stress on the following points :—
The two leading concepts of landscape gardening are :—(1)

To produce a "picture in the landscape." The house is in the majority of cases, the central figure of the picture. The green lawn serves as the canvas. The plantings complete the composition and colour, and (2) To resort to mass planting to produce the landscape effect, as the mass has greater value than individual planting, as it presents a much greater range and variety of forms, colours, shades, and textures, and as its features are so continuous and so well blended that the mind is not distracted by incidental and irrelevant ideas. The several other concepts which are subordinate to the above two and which also serve as explanations of the means and methods of making the picture are:—(i) To conceive of the plan as a unit. Each area must be set off from every other area and it should be such that the observer catches the entire effect and purpose of the picture without stopping to analyse its parts, every piece contributing to one strong and homogeneous effect. (ii) To have some one central emphatic point in the picture. Usually this is the house. (iii) To keep the centre of the space open, and fill up the garden frame on the sides with masses of plants. (iv) To avoid scattered effects. Flowers and high coloured foliage plants are most effective against a background of green foliage. The proper places for the flowers are along the borders against groups, often by the corners of the residence, or in front of porches. (v) To have the flowers only as incidents in the landscape picture. They serve to add emphasis, supply colour, give variety and finish. They are ornaments but the lawn and mass planting make the framework. (vi) To depend more upon the positions occupied by the plants with reference to each other and to the structural design of the place than upon the intrinsic merits of the plants themselves.

An extensive modern garden is usually made up of the following parts of features:—Roads, walks and paths, lawns, herbaceous borders, flower beds, rockery, climbers and creepers over arches and pergolas, shade garden, fernery or conservatory, water garden, trees and shrubs and so on. How to set about laying such garden, apparently complex and of diverse features, is the problem.

The garden-owner before commencing planting opera-

confines in large gardens. In small gardens, creepers may be grown on trellises above compound walls.

6. Let plants suited to the particular locality be selected and placed in environments suited for them.

7. An air of richness is essential in all gardens, large or small. This is provided by very careful selection of plants, ornamental and flowering, which planted out singly or in collections afford a mass of colour. Bougainvilleas Crotons, Cannas, Dahlias are very serviceable for this purpose.

8. Advantages already existing, such as trees, etc., should be utilised as far as possible.

The Lawn: A grass lawn has a charm all its own. It serves to enhance the beauty of a garden, be it large or small. It is a delightful foil to masonry and to brilliant flowers. Grass being one of the hardiest perennial herbs, it is not difficult to keep a lawn in good condition, provided one takes good care of it.

The view of the lawn from the verandah and the windows of the house should be free and uninterrupted. A spacious lawn may be enlivened by beds of flowering plants as Cannas or groups of shrubs as bright Acalyphas, or trees of attractive form as Araucarias, or specimen shrubs as Thuja orientalis or large succulents as variegated Furcraea and Agaves. Zephyranthes may be planted here and there in pockets made in the lawn to form colonies of themselves and bear their beautiful flowers peeping out of the fresh greengrass soon after a shower.

An ill-made lawn is a source of constant worry and disappointment. Some trouble should be taken to form a good lawn. The soil should be drained effectively if it is observed that water collects in pools and does not drain off after a heavy rain. In the hot weather, before the monsoons sets in, dig up the ground to a depth of about $\frac{1}{2}$ metre, pick out all stones and remove the roots of weeds etc. Expose the clods of earth to the scorching rays of the sun for killing weed-roots and to sterilise the soil. A day or two before the rains are expected, break the clods of earth and incorporate into the soil plenty of well decomposed manure and lightly roll the area. Level the surface by filling in depressions. For levelling,

drive in a number of flat-topped pegs at regular intervals; place a straight board on two adjacent plugs, proceeding from one direction and adjust the level of the board with the help of a spirit level. Let the soil settle down during the first showers. Remove any weeds that may come up. After the ground has thus been prepared, lay out the lawn by adopting one of the following approved methods. The best grass for lawns in India is *Cynodon dactylon*, known as Couch or Bermuda grass ("Doob", "Hariali", "Arukampillu"). It is low growing, hardy and responds to frequent mowing and provides turf of good colour.

(a) From seed. In this Country a lawn is seldom made by sowing seeds. A lawn from seed is thought of only when grass roots are not available. About 12 kg. of good seed may be necessary for an acre. The soil should be reduced to a fine tilth and given a light rolling. Seeds should be sown on a windless day, evenly and thinly and covered with fine light soil. The ground should be rolled again and watered liberally with the rose of a water-can or with hose pipe fitted with a nozzle which would water with very little force. For the first few times, cut the grass with a scythe. Use a lawn mower, when the roots have established and are spreading.

(b) By turfing. Turfs (pieces of earth with compact grass on them) should be cut uniformly thick in squares from a place where the grass is short, compact and free from weeds. They should be spread upon the prepared ground side by side and beaten down flat with a turf-beater. Any cavities in between should be filled with fine soil. Then the entire turfed area should be rolled and watered liberally. This is the most expeditious way of making a lawn.

(c) By "turf-plastering." Fresh Hariali roots should be cut up into bits, 2 to 4 cms. long. In a pit, a mixture consisting of two parts of these roots and a part each of well decomposed horse manure, fresh cow-dung and red earth or loam should be made and rendered into a paste by stirring it with the necessary quantity of water. Spread the paste evenly over the prepared ground which has, previously been watered, if necessary. Cover the ground then with litter or a layer of coarse manure to minimise evaporation and preserve the roots

from the heat of the sun. If there is no rain for the next two days, water liberally. Grass will shoot up in a fortnight. Cut with the scythe to start with and after three months, use the mower.

(d) By dibbling roots. This is the cheapest and the slowest method. Small roots should be dibbled about 15 cms. apart into the prepared ground when it is wet after a rain. The roots spread and grow underground in the course of six months, making fairly compact lawn, by frequent mowing, rolling and watering.

After making a lawn in one of the ways detailed above, rolling, mowing, watering, and restoration of patchy places should receive regular attention. Weeds should be pulled out as soon as they appear. Otherwise they soon spread, seed, multiply and overpower the grass. Fill up the gaps occupied by weeds with grass roots and fine soil. In the absence of rain, water the lawn every ten days heavily, soaking the soil through to a depth of at least 25 cms. As freely as the grass grows, mow it and roll it. This makes the lawn vetvety and thick. But do not use the roller when the ground is wet and sloppish. To have a perfectly green lawn feed it once a month with liquid manure prepared by dissolving 45 grams of ammonium sulphate in 5 litres of water. Rake the soil well with a rake or scarifier once a year before the rains, breaking up the old roots and top dress the soil with a rich mixture of well decomposed manure and sand. This stimulates vigorous new growths. Constant rolling often result in the formation of a hard crust on the soil which is responsible for the bare patches. To break such hard crusts of soil, beat the ground with a hammer provided with spikes set 5 cms. apart. The lawns may with advantage be sprayed with Bordeaux-mixture in diseased places.

The following are a few select plants suitable for planting on lawns, as single specimens.

Trees: *Amherstia nobilis*; *Brownea rosea* and other species; *Bignonia undulata*; *Callicarpa lanata*; *Callistemon lanceolatus*; *Cerbera odollam*; *Erythrina cristagalli*; *Magnolia grandiflora*; *Plumeria rubra* and *alba*; *Saraca declinata*; *Tabebuia spectabilis*. *Tabebuia argentio*; *Tabebuia guiacans*.

Araucaria; Cupressus funebris, pyramidalis and some others; Erythrina Parcelli; Pinus longifolia; Schinus molle; Thuja orientalis variety compacta.

Shrubs, creepers and foliage plants: Agave americana variegata; Agave Franzosonii; Furcraea Watsoniana; Dasyliron; Musa superba; Pandanus Veitchii and P. Sanderii; Bauhinia Galpinii; varieties of Bougainvilleas especially, K. S. G's "Gopal", "Partha", "Jayalaxmi", "Srinivasa", "Nigrette", B. Mary Palmer as a tall standard. B. Cascade, B. Gem, B. Dr. Hado; B. Purple Gem, B. Rosea, B. Blondie, B. Jennifer Fernie, B. Lady Mary Barrington, B. Golden Glow, B. Isabel Greensmith, B. Poultoni Special, B. Gladys Hepburn, B. Netalli, B. Kayata; Variegated leaved Bougainvilleas "Thimma", (as a standard) B. Rao, B. Glabra Variegata; B. Velayini, "Red Glory" and "Mahatma Gandhi" (this as a tall standard), B. Sanderii; B. Magnifica B. Formosam, B. "Pink-Beauty", B. Louis Wathen, B. Mrs. Butt; Buddleia Lindenii; Cestrum nocturnum; Clerodendron fallax or Kæmferii; Dombeya spectabilis; Hibiscus hybrids in varieties; Ixora, in varieties especially I. singaporensis; Kopsia fruticosa; Lagerstroemia indica; Nerium oleander (the large double rose and the carmine-rose double varieties); Gardenia florida; Hamelia patens (trimmed to shape), Allamanda Aubletti; Petrea volubilis (over a balloon) and its shrub variety; Cumquot orange (for its ornamental small coloured fruits); variegated Guava, etc.

Clumps of some tall ornamental and flowering grasses as Anudo donax variegata, Thyrsanolæna agrostis.

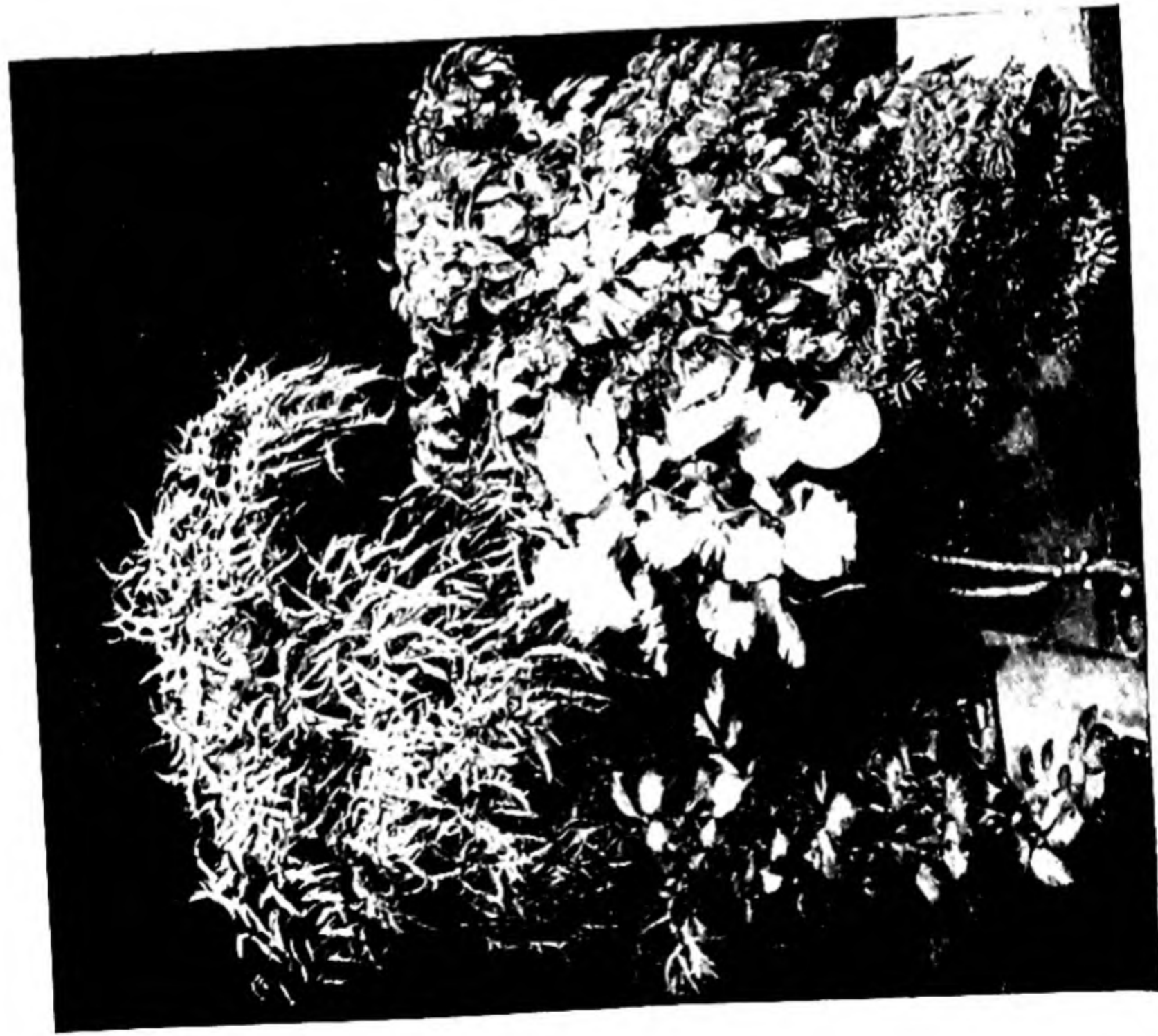
Shrubs and Shrubberies: Shrubs are plants, generally with woody stems, smaller than trees and bigger than most herbaceous plants. In a typical shrub, there are several woody stems arising from the same root. Shrubs are either deciduous or evergreen. Evergreen shrubs are generally slower in growth and more difficult to transplant than deciduous kinds. For horticultural purposes, shrubs can be conveniently classified under three heads, (1) those that are grown for their handsome foliage and form, (2) those that are grown for their attractive flowers and (3) those that are grown for their attractive, ornamental berries.

Shrubs play a great part in the garden scheme. On account of their permanent character, like trees, they form part of the framework of the garden. They form the chief feature of landscape gardening, placed in front of tall trees along the confines, and fringing the spacious lawn. Shrubs which are amenable to frequent trimming are chosen for topiary work; ornamentally clipped shrubs and standards are utilised to best advantage in formal gardens. A well designed shrub border consisting of a suitable admixture of choice deciduous and evergreen shrubs is a source of perennial pleasure. So are the smaller sized shrubs which can go effectively into herbaceous perennial borders supplying cut flowers throughout the year. Groups of shrubs planted by themselves in beds on lawns or as single specimens enliven the green sward. Again, groups of them planted next to the house serve to link the garden with the house. Tall growing shrubs are used to screen from view disagreeable objects as the pivy, dust bin, the manure pit and so on, and to shut off the view of the kitchen garden from the ornamental garden. Handsome shrubs as *Ixora*, *Thuja*, *Bougainvillea*, etc., make charming tub-plants.

For planting shrubs, prepare pits about a metre each way, and fill them with good soil mixed with 2—4 baskets of well decomposed manure, if the soil of site is not good. Prepare well the ground in between, by digging it about $\frac{1}{2}$ metre deep and removing all weeds. Space the shrubs at suitable distances apart. When they mature and reach their maximum growth, they should not overcrowd and cut off light and air to each other. Do not allow them to grow straggly or form clumps by throwing suckers from the base, unless they are grown only for purposes of propagation. By cutting away straggly shoots and rigorously suppressing sucker growths, the activities of the shrub are directed to a more plentiful and richer inflorescence. Keep the soil under the shrubs well aerated by hoeing now and then. This will save a lot of watering. In summer, mulch the surface of the soil with lawn, clipping or litter, etc. If the soil is infested with white ants, mulching with leaf mould or litter should be avoided. The ground should be dug up and the top clods should be just powdered to form a soil mulch. Manure the shrubbery at least once a year, digging



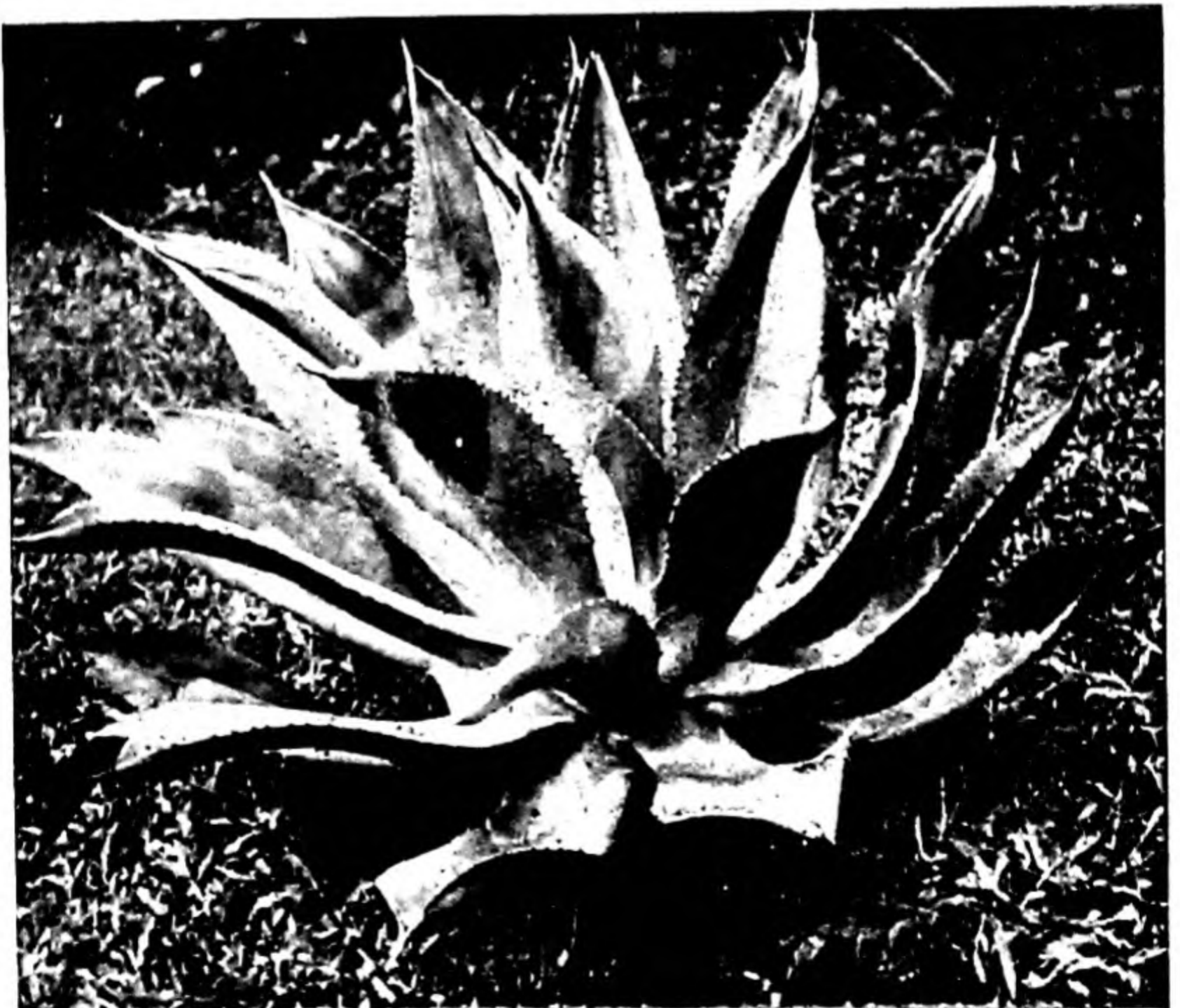
ARECA LUTESCENS GROWN IN THE CENTRE
OF A LAWN



A COLLECTION OF PANAXES,
IN THE CENTRE IS PLANCASTRII



AGAVE AMERICANA MEDIOPICTA



SPECIMEN AGAVE PLANTED IN A LAWN

in plenty of cow or horse dung, before the rains. During the rains, the manure gives its full benefit to the plants. Study the habits of growth and flowering of the particular shrubs and prune them accordingly (see Chapter X).

Standards : Shrubs may be trained to a single stem and allowed to branch out and form a handsome head only above a particular height, when they are known as standard. There are a number of shrubs such as *Achania*, *Bougainvillea*, *Ixora*, *Holmskioldia*, *Hibiscus*, *Murraya exotica*, *Lantana*, *Lagerstroemia indica*, *Tecoma radicans*, *Allamanda grandiflora* etc., which may be trained to standard forms without much trouble. Favoured varieties of Roses may be budded on to tall stocks of Edward or the Briar Rose to form handsome flowering standards. *Epiphyllum* and *Phyllocactus* herbaceously grafted on tall stocks of *Cereus* make very ornamental plants. Herbaceous perennials as *Geranium*, *Fuchsia*, *Hydrangea*, and *Heliotrope* are effective as small standards.

For making standards, select specimens with a tolerably straight central stem. Cut away all side growths close to the

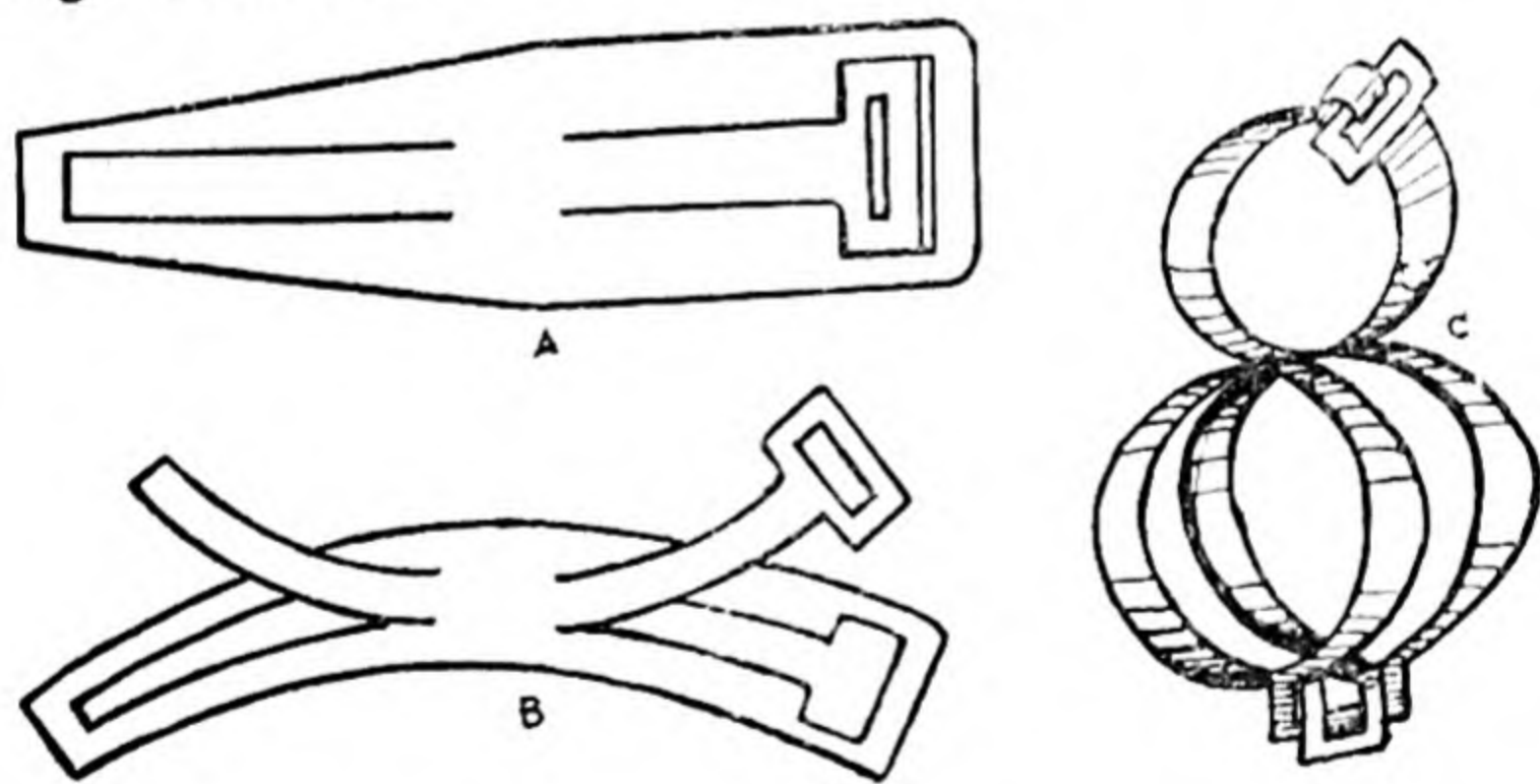


Fig. 62

Take a piece of zinc plate and cut it in the form shown in A and along the lines shown. Then the cut bit could be bent into circles as seen in B and then clasped round the stem and the stake as in C.

central stem and remove all suckers to the ground level. Provide the plant with a stout stake and fasten it with clasps, made of galvanised iron or zinc strips. They can be cut into

the form shown in Fig. 62. Keep the shoot growing till it attains the desired height—say $\frac{1}{2}$ to $1\frac{1}{2}$ metres or more—and then pinch out the top, 10 cms. or so above a pair of leaf buds. Soon shoots emerge from below. Prune these and the side shoots originating from them till a good head is formed. In course of time, by careful and close pruning of the new growths as often as necessary, a neat cup-shaped head will be formed. Watch for growths from the stem below the head and for suckers from the root and remove them, as they grow at the expense of the standard and would kill it in course of time.

Standards and half-standards are invaluable for decoration of terraces. In formal gardening, they are planted alongside walks and paths in beds containing low growing plants as Moss Verbena. Standards may be effectively used to ornament lawns. Even in herbaceous and shrub borders, they may be effectively planted to show their bunch of colour amidst dark evergreen foliage or less striking flowers.

Flower beds : Flowers are most effective when massed in beds. They give real colour—bright and cheerful and lasting for a long time. In India, with a well-arranged and thought-out scheme, one can easily have a succession of delightful flowers by periodical planting. Some kind or other, annual or perennial, can be grown almost throughout the year in beds. As several places in India vary widely in climatic conditions, the sowing time of annuals vary accordingly. Generally, in the plain country, up to an elevation of about 600 metres, the sowing of some annuals is done from October to December for flowers in the hot weather. Again, sowing of certain kinds is done in April and May for flowers in the rainy weather. For flowers in early cold weather, sowing is done late in July or in August. Generally, all those kinds which are sown from October to December in the plains are sown in March to May on the hills.

Flower beds should be simple in design, either square, rectangular, circular or oval. Not only are such simple designs executed easily but they are in less danger of getting out of shape during digging operations, than complicated patterns possessing numerous points, angles and curves.

The number and size of flower beds in a garden are determined by its extent and type. In a strictly formal garden, flower beds are picturesquely laid out in well marked-out bits in pairs; they form the chief feature of the garden along with the topiary and ornamental trees and shrubs such as *Araucaria*, *Cupressus*, *Thuja*, ornamental Palms and the like. In the landscape style, flower beds are comparatively less in number and they are given only a secondary importance. Flowers are chiefly grown in the borders and in front of shrubberies to brighten the landscape view. In the free style of gardening, the position and number of flower beds are determined by their necessity and by the effect they are calculated to produce. Beside lawns, on lawns, and along main walks flower beds find their usual place.

In the garden scheme, the tallest growing species, are planted at the back of borders or along compound walls or in beds on lawns far away from the residence. The medium sized plants are planted in the central area and the dwarfish growing ones in the front. In filling any one bed with different kinds of annuals or herbaceous perennials, the same principle is followed.

One should have a taste for arranging the colours in one's garden. There should be a harmonious blending of colours in the colour scheme of the garden to make a pleasing picture. Colours are said to harmonise when different shades blend insensibly into each other. The spectrum or the rainbow colours merge into one another in the following way, red with orange, orange with yellow, yellow with green and so on. Harmony is easily determined by the eye. A gradation from red to deep pink, light pink, and white is pleasing. The stronger colours which attract the eye before the milder ones should find their place in remote beds near the margins, and on the flanks. For instance, the bright scarlet *Salvia splendens* and the deep yellow Marigolds are distressing when placed directly in front of the house in small beds. The blues, the lilacs, the light purples and the roses would be suited for the front.

It may not be possible always to give an ideal aspect for all flower beds. Far away from the robbing roots of trees

and in bright sunshine, thrive most bedding plant, though some may do well in semi-shade also. Flower beds should be dug up at least 15 to 20 days before sowing or bedding out small plants. For most annuals, it would be enough if the soil is worked to a depth of $1\frac{1}{2}$ metres. But for deep-rooting plants such as Sweet Peas, Cannas, etc., the bed should be dug up to 2 metres. If the soil is bad, it should be improved by adding sand to heavy soil and heavy loam to light soil. Plenty of well-sifted leaf mould and well decomposed horse or cow-dung, should be incorporated into the soil long before the beds are got ready for planting. If the soil is too bad to be improved conveniently quickly, it should be removed to the necessary depth and replaced with fresh compost, the best being the one which is generally used for pot plants. A week before planting or sowing, break up the clods of earth, remove stones and pebbles and mix the manure well in the soil. A basket holding about 6 kg. of manure should do for about 16 sq. metres of space. Level the bed in such a way that it slopes slightly and uniformly from the center to the edge. In rainy season, rise the level of the bed by 7 to 15 cms. above the surrounding ground to prevent flooding. Three or four hours before sowing or planting, water the bed freely. Before planting mark out the positions to be occupied by the plants. The height and area that each plant would occupy when mature should be taken into consideration. When in bloom, the plants should just touch each other giving a continuity in flower and leaf from plant to plant. Overcrowding would result in weak-stemmed plants which would topple, one over the other, and would not bloom satisfactorily. A clear space of 7 to 15 cms. should be left unfilled by plants by the edge of the bed. For planting, make a hole with a trowel or dibber large enough to accommodate all the roots of the plant with the soil attached to them. Draw earth over the roots of the plant after putting it in the hole and press the soil lightly all round. The depth of planting depends upon the kind of plant and its habit of growth. Balsams, for instance, are covered up to the level of their second set of leaves. Several other annuals are covered up to the level of their first seed leaves. The soil should be soft and mellow at planting time.

If too dry, it would not allow a good opening to be made for planting; if too wet, it would be sticky and very inconvenient to work. While planting large beds, wooden boards or stone slabs should be placed at convenient distances apart in the beds for stepping on to avoid foot-marks in the bed. After planting, the bed should be copiously watered with a watercan furnished with a rose. If the weather is not cloudy, the tender plants should be protected from strong sun by shading them with green twigs stuck into the bed. Till the plants establish and begin to grow, watering should be carefully done. Any excess may end in their rotting, and want of water will end in their withering away. The shade should be removed after the plants establish, which is generally in a week.

Attend to the needs of the flower bed now and then. Without disturbing the roots, stir the surface soil to a depth of about 5 cms. every fortnight as this amount of aeration of the soil would stimulate the plants to vigorous growth. This scarifying of the soil is especially necessary after a rain when the surface hardens and cracks. When the plants turn yellowish in leaf, either they suffer from too much of water or for want of nourishment in the soil or from the activities of root-eating grubs. Examine the soil for these and pick them out. Feed the plants with weak liquid manure once a week or ten days or fork in well-decomposed manure in between the plants.

Carpet beds : Carpet beds which were very common in formal gardens of old, have ceased to be a fashion now. But, they are interesting in their own way. Carpet bedding consists in covering a bed or series of beds forming a design, with close low-growing plants. Foliage plants are better suited than flowering plants, as they stand severe clipping much better. In the design are brought out certain figures and letters by means of plants with varying habits of growth or having differently coloured leaves. It is usual to have a background of plants of one colour and to run through it plants of other colours in masses, stripes or ribbons, so as to produce the artificial effect desired. Carpets are designed in a number of ways, according to the taste of the gardener and the plants at

his command.

Carpet beds are troublesome to maintain in good condition. They require constant attention. The plants should be trimmed now and then, not allowing them to outgrow their own limits in the pattern. Vacant spaces arising by death of plants caused by root-eating grubs or otherwise should be filled with similar plants, a stock of which should be kept ready for use. The beds should receive once in three months, a dressing of well-decomposed manure which has been carefully freed from larvæ of beetles.

The following are a few select plants that are useful for forming carpet beds:—

Alternanthera (Amaranthaceæ). Small evergreen herbaceous perennials, growing 15 to 20 cms. high, with small leaves, coloured and tinted with orange, scarlet, yellow, bronze, rose and purple shades, there being several species. All are easily raised from cuttings, inserted where they are wanted to grow, 5 cms. apart. They stand trimming well and thrive in the sun.

Cineraria maritima (Compositæ). Popularly known as the "Dusty Miller" with silvery downy leaves. Propagated from cuttings. Grows 25 cms. to 50 cms. high and stands trimming.

Coleus salicifolius and other dwarf species. (Labiatae) Dwarf spreading types of *Coleus* with attractive coloured leaves, growing 15 to 20 cms. make good plants for ribbon effect. Propagated by cuttings or from seed.

Echeveria (*Cotyledon*) *secunda* and other species (Crasulaceæ). Succulent leaved plants, with dense rosette of leaves, which are almost round. Grow 7 to 15 cms. high. Raised by suckers, cuttings, leaves. Only suited to medium and high elevations. Remove flowers to retain plants in good condition. Replace old plants which have no leaves at the bottom with new ones.

Herniara glabra and its variety *aurea* (Illebraceæ). Called Rupture wort. Ornamental trailing herbs about 3 cms. high, with ornamental dark green or golden coloured leaves. Raised from seed or by division.

Impatiens repens (*malabaricum*) (Balsaminaceæ). Herbaceous compact low growing plant with reddish succulent

stem and yellow bright flowers. Leaves are succulent and small. Excellently suited for rockeries, hanging baskets and low bedding. Liable to damp off in summer. Hence make a number of plants by cuttings to safeguard against loss.

Iresine in varieties. See under ornamental foliaged shrubs.

Lobelia succulenta (Campanulaceæ). Called the Nilgiri Grass. Dwarf spreading perennials with grass-like foliage, flattened to the ground. The variety *L. succulenta rubra* is pretty. These are marsh plants, which are easily raised by division.

Paronchia argentea and capitata (Illebraceæ). Known as Nail-wort or Whitlow-wort. Dwarf creeping perennial herbs, about 25 cms. high, with white flowers surrounded by silvery bracts. Propagated by division or from seeds, sowing them where they are wanted to grow.

Pilea (Urticaceæ). Small herbs 7 to 20 cms. high with graceful fernlike foliage consisting of minute thick leaves. Make mosslike growths. *P. muscosa* is perhaps the best species.

Portulaca (Portulacaceæ). Low growing annual with trailing stem and short thick leaves and brilliantly coloured flowers. Raised from seed.

Pyrethrum aureum and other species (Compositæ). Known as Golden Feather. A pretty golden foliaged herb, 15 to 25 cms. high. Better suited to high and medium elevations than to the plains. New plants should be made every year in the plains where the colour deteriorates after a year. Raised from seed or by cuttings or by division.

Santolina chamæcyparissus (Compositæ). Called the Cotton Lavender. An evergreen shrubby plant, 30 to 45 cms. high, with strongly scented leaves and shoots which are covered with cottony down. Raised from seed and by cuttings.

Scutellaria andamanensis (Scrophulariaceæ). A small herbaceous perennial, 10 to 15 cms. high, bearing whitish flowers.

Sedum (Crassulaceæ). Called Stonecrop. Showy succulent herbs, about 10 cms. high. *Sedum rupestre* is an excellent species. *S. hexangulare* can be grown satisfactorily at low elevations. Others do well in cool places at medium and high elevations.

Sempervivum (Crassulaceæ). The House Leek. Stemless

succulent plants with fleshy green and variegated leaves, mostly in rosettes, thriving only from medium to high elevations. Grow 15 to 30 cms. Suited for carpet bedding and rockeries.

Spergula=*Sagina glabra* and its variety *filifera aurea* (Caryophyllaceæ). Known as the Pearl Weed or Pearl Wort. Perennial evergreen herbs, 5 to 10 cms. high, with ornamental foliage and flowers. The stems are creeping and the leaves are narrow, green or golden yellow.

Torenia asiatica (Scrophulariaceæ). A creeping perennial herb, with purple flowers like those of *Torenia Fournierii*.

Vittadenia australis (Compositæ). A creeping perennial herb with dark green small leaves and daisylike tiny white flowers.

The following flowering plants are also suited for carpet bedding : Dwarf semperflorens Begonias, Lobelia erinus compacta, Gazania, dwarf Ageratum, dwarf Alyssum, Pansy "Celestial, Queen", dwarf Phlox Drummondii.

Borders : Borders are continuous beds of more length than width containing plants of a heterogenous character as distinguished from flower beds which are composed of plants of one kind only. Borders are named differently as shrub or herbaceous perennial or mixed borders according to the plant material used to fill them. When composed mainly of shrubs, they usually skirt along walls or run in front of a row of trees behind them or in front of hedges and fences forming the boundary or screening undesirable places as manure pits, etc. A *herbaceous border*, is mainly composed of herbaceous perennial plants of varying habits of growth and colours of bloom. A *mixed border*, as the name indicates, includes (a) shrubs which are not very heavy and woody and do not take much root space, (b) undershrubs which are smaller than shrubs and have comparatively soft stems, (c) herbaceous perennials, (d) annuals which flower in masses and last for a long time in bloom, and (e) such bulbous plants as Dahlia, Canna, Tuberose, Amaryllis, Zephyranthes, etc., which are striking. A mixed border may be composed of perennial herbaceous flowering plants and annuals and biennials or only of annuals, when it is called an *annual mixed border*.

A border serves the means of bringing together in harmonious association a large number of plants which need not be grown separately in beds. It enables the keen gardener to study at a glance the habits and requirements of a number of varieties of plants which are also a perennial source of supply of cut flowers for decoration indoors and are thus of entrancing interest to him. There is no wonder then, that borders are the chief attractions of all modern gardens and have replaced formal flower beds and rows of pot plants staged in tiers.

A heavy shrub border usually skirts walls and forms the framework of the landscape view along with the trees behind it. Other kinds of borders are effective on the verge of lawns, besides important walks and paths and the carriage drive, in front of massive shrubberies, hedges, walls, and trellis. It is essential that borders should be sheltered from high winds and should get the full benefit of the sun. The site should be dug up to a depth of $\frac{1}{2}$ to $\frac{3}{4}$ metres and well incorporated with decomposed manure. If soil is wanting in drainage, it should be attended to. The method of planting to be followed depends on whether the border is single or double fronted. If it is single fronted, the tallest plants are put at the back and the dwarf plants in the front, such that the plants present a sloping aspect from the back to the front. If the border commands two aspects, the tall plants are placed in the middle of the border in a row, the medium sized plants next to them on either side and the small growing ones next to these and edging them on either fronts. Unless the border is 3 to 4 metres wide, there cannot be any freedom in planting. Only small plants can be thought of for borders measuring $\frac{3}{4}$ to 1 metre. Bold masses of colour cannot be attempted in a cramped space. But an annual mixed border is effective and artistic even if it is only 1 metre wide. The choice of plants for filling the border should be such that at no time is there any patchy effect. Similar plants are best planted in groups of three and fives far apart from each other for effecting displays of masses of colour. Lanky growing specimens should be placed by bushy plants to cover their nude stems so that only their blooms may be visible above the foliage of adjoining plants.

A shrub border only demands annual manuring and hoeing and mulching in dry weather. A herbaceous border requires greater attention. As the plants soon get exhausted in this enervating climate of ours, they should be frequently fed with top-dressing of well decomposed manure or applications of liquid manure. They should be regularly watered. Suckers should be now and then removed from plants which are inclined to form clumps, to enable them to bloom well. Vacant spaces caused by death of plants should be replanted whenever necessary. A well prepared herbaceous border need not be disturbed for a year at least.

It should however be mentioned that formation of borders and especially the herbaceous borders, is not a simple matter. It requires an intimate knowledge of the kinds that succeed best, their habits of growth, the heights they attain to, the season and duration of their blooms, and the sequence of flowering of the various plants which make up the border. The plants should be of a hardy nature, and bloom strikingly for a long time. Our climate does not permit us having a successful and effective herbaceous perennial border as in England and such countries in the temperate zone. Our selection is restricted to a few good kinds only, and we should utilise them to best advantage. The tall growing Delphiniums, double Hollyhocks, taller growing Michaelmas Daisies and several such ornaments of the English borders, we cannot have in our borders in the plains. The following herbaceous perennials and soft wooded small shrubs would be found useful for forming a herbaceous border in the plains of this country :—

Aerua tomentosa and *Sanguinolenta*

Asclepias curassavica and its yellow variety.

Amaryllis in varieties.

Angelonia in varieties.

Asystasia in varieties.

Barleria in varieties.

Beleperone in its attractive varieties.

Canna in varieties.

Clerodendron Balfourii and *Thomsonæ*.

Chrysanthemum Cascade, Korean, etc.

Coreopsis grandiflora.

Crossandra undulæfolia and others.

Cooperanthes in different colours.
 Dædalacanthus nervosus and Wattii.
 Eranthemum laxiflorum.
 Gaillardia perennial.
 Kalanchœ in attractive flowering varieties.
 Lantana Sellowiana and depressa.
 Michælmæ Daisies (Perennial Asters).
 Orthosiphon stamineus.
 Pentas carnea in varieties.
 Plumbago capensis and varieties alba and rosea.
 Portulaca.
 Rudbeckia perennial.
 Russelia juncea and floribunda.
 Ruellia in varieties.
 Salvias, leucantha, farinacea, azurea, coccinea, etc.
 Solidago (Golden Rod).
 Turnera elegans and ulmifolia.
 Verbena, perennial varieties.
 Vinca in varieties.
 Zephyranthes in varieties.

Five lists of plants are given below, with a view to help the amateur in his attempts to form a *mixed border*, which is the easiest kind of border to form and the best suited for our country for low and medium elevations. Unless planned on a very large scale, it is advisable not to include in the mixed border plants which have a large spread or grow into almost small trees. List A include the tallest kinds and list E includes very dwarf edging plants and the other lists furnish plants in the descending order of the heights they grow to.

Descriptions and cultural notes of the plants mentioned in the lists are given in Part II of the book. Following abbreviations are used to indicate the nature of the plants :
 A = Annual ; B = 'Bulbous' plant ; F = Foliage ; S = Shrub ;
 SS = Soft wooded shrub ; H.P. = Herbaceous Perennial.

List A.

Height. 1.5 to 2 metres
 Acalypha illustrata, tricolour, and such other ornamental
 foliated varieties. (FS)
 Achania Leschenaultii. (S)

- Amaranthus ruber.* (A)
Arundo donax variegatas. (Tall Grass)
Bougainvilleas, varieties. (s)
Caesalpinia pulcherrima. (s)
Datura suaveolens. (s)
Hibiscus mutabilis, *Aliporensis*, and other tall varieties. (s)
Lochroma tubulosa, in blue and purple varieties. (s)
Lagerstroemia indica in varieties. (s)
Montanoa bipinnatifida. (s)
Nerium Oleander in varieties. (s)
Panax Lancaserii, *Victoriæ* etc. (FS)
Poinsettia in pink, white, and red varieties. (s)
Sanchezia nobilis variegata. (FS)
Helianthus argyrophyllus and double tall varieties. (A)
Tabernæmontana, tall perpetual flowering kind. (s)
Tecoma stans, *Chrysantha*, and *Smithii.* (S)
Verbesina gigantea. (s)

List B.

Height. 1 to 1.5 metres

- Brunfelsia americana Lindleyana* and *nitida.* (s)
Canna, tall varieties. (B)
Cestrum aurantiacum, *elegans.* (s)
Clerodendron ugandense, *Minahassæ*, *Pyramidalis*, etc. (s)
Dahlia, tall kinds. (B)
Dombeya alba magnifica. (s)
Eranthemum hypocrateriforme. (s)
Gardenia florida. (s)
Hibiscus in varieties. (s)
Hollyhock. (A)
Ixora singaporensis, *Prince of Orange*, etc. (s)
Justicia chrysostephana. (s)
Lantana white. (s)
Mussaenda luteola. (s)
Pennisetum longistylum. (G)
Stachytarpheta rosea. (s)
Tabernaemontana coronaria. (s)
Tecoma capensis. (s)
Thunbergia erecta in varieties. (s)
Tithonia speciosa. (A)

List C.

Height. $\frac{3}{4}$ to $1\frac{1}{2}$ metres

- Aerua tomentosa.* (ss)
African Marigold. Tall. (A)
Barleria. Tall kinds. (ss)
Beleperone Amherstiae, oblongata. (ss)
Buddleia Lindenii. (s)
Canna, tall and medium. (B)
Clerodendron pholmoides. (s)
Dædalacanthus nervosus. (ss)
Galphimia glauca. (s)
Gladiolus. (B)
Heliotrope. (ss)
Ixora stricta and rosea. (s)
Justicia carnea. (ss)
Kopsia fruticosa. (s)
Lantana yellow. (s)
Malphigia coccigera. (s)
Pentas carnea, red. (ss)
Plumbago, blue, white and red. (ss)
Rondeletia speciosa. (s)
Russelia floribunda and juncea. (ss)
Salvia uliginosa. (HP)
Thrysanolæna agrostis. (Grass)

List D.

Height. $\frac{1}{2}$ to $\frac{3}{4}$ metre

- Amaryllis or Hippeastrum hybrids.* (B)
Angelonia grandiflora and its varieties. (HP)
Antirrhinum majus. (A)
Barleria Gibsoni, cristata and its varieties. (ss)
Asystasia coromandeliana, Travancorcan, (HP)
Browallia elata minor. (A)
Chrysanthemum frutescens, indicum. (HP)
Campanula pyramidalis. (HP)
Cleome. (Spider flower). (A)
Coreopsis grandiflora. (HP)
Coreopsis tinctoria, etc. (A)
Crossandra. (ss)
Eranthemum laxiflorum. (ss)

- Gaillardia. (A)
 Heliotrope. (HP)
 Michaelmas Daisy. (HP)
 Salvia leucantha, farinacea, splendens and its varieties. (HP)
 Vinca rosea and varieties, (ss)

List E.

- Height. 7.5 cms. to $\frac{1}{2}$ metre
- Ageratum, dwarf blue and white. 15 to 30 cms. (A)
 Alternanthera. Coloured foliage. 15 cms. (HP)
 Asters, in different colours. 20 to 45 cms. (A)
 Begonia semperflorens. 20 to 40 cms. (HP)
 Brachycome. 15 cms. (A)
 Candytuft, 15 to 25 cms. (A)
 Coreopsis Drummondii and dwarf varieties.
 20 to 45 cms. (A)
 Cooperanthes. 15 to 25 cms. (B)
 Dædalacanthus Wattii. 20 to 25 cms. (ss)
 Dianthus. Pinks. 20 to 25 cms. (A)
 Gerbera. Double and single. 22 to 25 cms. (HP)
 Lantana depressa. 30 to 37.5 cms. (ss)
 Lantana Sellowiana. 10 to 17.5 cms. (ss)
 Michaelmas Daisy. 20 to 45 cms. (HP)
 Oxalis Theroroides rubra. 22.5 to 30 cms. (HP)
 Phlox Drummondii. 12.5 to 22.5 cms. (A)
 Portulaca. 7.5 to 10 cms. (A)
 Rudbeckia. 20 to 30 cms. (HP & A)
 Salvia azurea. 22.5 to 30 cms. (HP)
 Salvia coccinea. 30 to 45 cms. (HP)
 Verbena hybrida and erinoides. 15 to 22.5 cms. (A ; HP)
 Zinnia linearis. 22.5 cms. (A)
 Zephyranthes 15 to 22.5 cms. (B)

Hedges: A live high impenetrable hedge, reinforced if necessary by one or two strands of thick barbed wire concealed in it, kept neat and tidy by trimming it to shape and keeping it within bounds, forms a natural boundary to a garden and it is hence preferred to compound walls by many. Not only is it effective in protecting the garden from trespassing cattle and thieves but also ensures privacy and affords a pleasing sight when fresh with foliage or when in bloom. If

tall enough, say 25 to 30 cms. a boundary hedge serves as a wind screen as well. The best material for forming such a hedge would be a quick growing hardy shrub of a scandant or climbing habit of growth with attractive small foliage and handsome blooms. It should be a kind which does not attract snakes; it should be drought resistant; it should stand trimming to shape and it should be capable of being easily and quickly raised from seed or from cuttings to fill up gaps promptly.

Ornamental internal hedges are formed of small growing shrubs or undershrubs which have handsome foliage and bear in some cases handsome flowers as well. The usual height for an ornamental internal hedge varies from 30 to 65 cms. Its object is to seemingly divide the garden into a number of parts, each containing a distinct feature of its own as a rosary or flower beds or plantation of bulbs, etc., each part being visible from the other over the short hedge, which is an attraction by itself. In a large garden several such hedges, like so many edgings, comprised of different kinds of plants break the feeling of flatness and enliven it.

As the boundary or the screen or the ornamental hedge are all meant to be permanent features of a garden, a certain amount of trouble should be taken in the preparation of the ground and in planting them. A good trench 30 to 37.5 cms. wide and 37.5 to 45 cms. deep should be dug up and left exposed for a fortnight or a month, after which it should be filled with the soil enriched with manure. It is best that top layers of soil to a depth of 22.5 to 30 cms. do not contain manure, as it will not help the newly planted cuttings to strike root, but only will attract white ants to them. If the soil is too light or clayey or gravelly, it should be improved as recommended in Chapter III. The planting of a hedge is usually undertaken only in the rainy season, in August. Either seeds are sown or cuttings inserted or rooted cuttings planted, the distance apart for sowing or for planting depending upon the nature of growth of the particular plant. Plants of such trees as *Polyalthia longifolia* or *Inga dulcis* or *Pongamia glabra*, may be planted 75 to 90 cms. apart. Shrubs may be planted from 15 cms. to 45 to 60 cms. apart. Seeds should be sown or cutting planted in two rows 15 cms. apart

triangularwise thus $\therefore \therefore$ Regular and thorough watering is necessary in the dry season for the hedge to be in good condition. Shoots should be tipped as they grow to induce them to branch out and the side shoots should be cut back to the desired dimension. A square hedge is the easiest to make. Only a few kinds of plants are allowed to grow to the desired height and then trimmed to shape. Most kinds are regularly trimmed and pruned for every top growth of 15 to 22.5 cms. till the desired height is reached. This ensures a square formed hedge. An ill pruned or badly formed hedge presents a broad top and is wedge-shaped. A compact and a thick hedge is possible if it is trimmed as often as necessary, cutting back the overgrowing shoots strictly to the desired dimension.

Two lists of plants are given below which are suited for forming boundary and ornamental internal hedges respectively. Several such kinds as Cactus, Opuntia, etc., have been omitted, as there is not much to recommend them for a home garden except their thorny nature which helps to keep off cattle.

A. Plants suitable for ornamental internal hedges : Refer to index for pages dealing with the plants mentioned below.

**Acalypha* : Dwarf - growing species as *A. Hamiltoniana* can be trimmed well, keeping the hedge neat from 45 to 90 cms. high. Foliage brightly coloured. Plant rooted cuttings 20 to 30 cms. apart.

Barleria : Undershrubs, with very pretty flowers capable of being trimmed to an attractive hedge, 60 cms. high. Plant rooted cuttings 22.5 to 25 cms. apart.

**Bougainvillea* : Of *Bougainvillea* *B. glabra* *Sanderii* and *Mrs. Fraser* are particularly suited as they stand trimming well and fill up well. Plants 60 to 90 cms. apart. Train shoots along barbed wire or trellis and cut back side shoots and leaders to freely branch and bush out.

Buddleia Lindleyana and *B. Veitchii* : Plant rooted cuttings 30 cms. apart. Can be trained to a handsome hedge bearing scented lilac-blue flowers in long spikes. The plants are short-lived and hence, the gaps should be filled every now and then with plants kept ready for the purpose.



Plate 3 ANTHURIUM COLLECTION

* *Clerodendron inerme*: Forms one of the best and popular evergreen hedges, which can be continually trimmed with immunity to shape it. It is very hardy, drought resistant, and responsive to good treatment. Leaves are polished green and disagreeable smelling when bruised and hence, this hedge is supposed not to harbour reptiles. It takes about two years to form a good hedge, as the shrub is rather slow growing. Flowers are white and borne in small clusters. But as they detract from the value of the perfectly pleasant green foliage, they should be trimmed away. Plant cuttings of 15 to 20 cms., 15 to 20 cms. apart, in two rows. Plant again if several fail to root. Trim at every stage of growth.

Cupressus: Dwarf species as *C. macrocarpa* form very attractive hedges in medium to high elevations. At low elevations, require protection from strong sun. Evergreen, ashgreen, pretty foliage. Plant young plants, about 15 cms. high, in two rows, 30 to 45 cms. apart.

Daedalacanthus nervosus: Hedge, 30 to 45 cms. high, with pretty dark green foliage and deep violet spikes of bloom in plenty. Raise plants from cuttings or seed and plant them 22.5 to 30 cms. apart in two rows.

* *Duranta*: A very suitable hedge plant thriving in almost any kind of soil and easily propagated from seed or cuttings. Plant 30 to 45 cms. apart. If not sheared too frequently, handsome blue or white flowers are produced, and these are followed by charming yellow berries. The hedge grows even under shade. The variegated species is very ornamental. Trimmed 1 to 2 metres.

Eranthemum nobilis: With its green leaves which are veined with yellow, the hedge is ornamental when kept at 60 cms. high. Plant cuttings 15 cms. apart in two rows.

Other kinds of *Eranthemums* as *E. cinnabarinum*, *E. Goldeana*, *E. versicolor* as also the allied *Graptophyllum hortense* are used for hedging too.

Euphorbia Bojeri: A hedge, 45 to 60 cms. high, is pretty with its foliage and bright scarlet flowers. Plant cuttings 22.5 to 30 cms. apart.

* *Eupatorium cannabinum* *E. heteroclinium*: (Compositæ). Makes an excellent internal hedging up to 60 cms. high.

Plant closely 15 cms. apart and trim constantly. Light green foliage and Ageratum-like flowers.

Hamelia patens : Forms an attractive hedge with ever-green greenish brown foliage of small leaves. Stands close trimming to shape. Plant 30 cms. apart. Slow growing but elegant when kept well. Proper height, 75 to 90 cms.

* *Hibiscus* of kinds : especially *rosa sinensis*.—Hardy and quick growing. Needs constant trimming. Pretty ; kept 75 to 90 cms. high, with the bright flowers peeping out here and there from among the rich green polished foliage. The allied *Achania* also forms an attractive hedge.

Justicia gendarusa (Acanthaceæ) : Keep at 60 to 90 cms. A quick grower, bushy, with white insignificant flowers. Propagated from cuttings. Plant 30 cms. apart.

Lantana : Forms a good hedge, standing trimming very well. Flowers are handsome but should not be allowed to seed, as the kind spreads like a weed. The yellow and the white flowering kinds are comparatively dwarfs and are hence good for short hedges 45 to 75 cms. high. The commoner varieties can form hedges even 1½ metres high. Put down hardwood cuttings in June-July *in situ*. Allow the plants to grow up and trim in stages for bushing out. Will grow to 1½ metre in a year or two.

Malpighia glabra and coccigera : Small green leaves and pretty flowers. Plant 22.5 to 30 cms. apart. Keep the hedge at 60 to 90 cms.

Meyenia (= *Thunbergia*) *erecta* : Keep the hedge 45 to 60 cms. Pretty blue flowers peeping through the dark green foliage. Very ornamental with its fresh foliage and stray flowers peeping through it. Plant rooted cuttings 15 to 30 cms. apart,

* *Pedilanthus tithymoloides* (Euphorbiaceæ) : Called the Slipper Plant or Jew Bush. The variegated variety with creamy white and green leaves borne on cylindrical thick stem which is also of the same colour is pretty, if kept trimmed at 60 to 90 cms. The whole plant contains an acrid milk. Hence neither cattle nor goats touch the leaves. Easily raised from cuttings, which may be planted 12.5 to 15 cms. apart.

* *Plumbago capensis* : Makes a very attractive hedge,

30 to 90 cms. high. Plant suckers or rooted cuttings 15 to 25 cms. apart.

Serissa foetida. (Rubiaceæ) : Dwarf pretty small shrub ; can be kept at 60 cms. high, with small shining dark green leaves ; bears white flowers, which when bruised emit an unpleasant smell.

Strobilanthes anisophyllus : Known as Gold Fussia. Keep the hedge down at 45 to 60 cms. Loves shade.

B. Plants suitable for boundary or tall hedges : Refer to index for pages dealing with the plants mentioned below.

* *Acacia Farnesiana* : Makes a good thorny hedge kept thick at $1\frac{1}{2}$ metres high by constant pruning. Sweet scented flowers. Plant seedlings 30 cms. apart. *A. concinna* and *A. modesta* also make good hedges, suitable for large estates.

Acalypha : Taller species can be trimmed to a hedge, $1\frac{1}{2}$ metres high. Plant rooted cuttings 30 cms. apart.

Agave americana and other tall growing species : Make ornamental barriers, 1 to $1\frac{1}{2}$ metres high.

Aralia filicifolia and other tall growing species : Ornamental foliage. Height 1 to $1\frac{1}{2}$ metres. Plant rooted cutting 30 cms. apart.

Bambusa, dwarf kinds : Make thick but uncouth fences, harbouring snakes. *Bambusa nana* is the best species for the purpose.

* *Bougainvillea* : Keep at $1\frac{1}{2}$ to 2 metres high. *B. glabra* is the hardiest for the purpose. *B. Cypheri* is dwarf growing and bushy. *B. Gems* is ideally suited.

Cæsalpinia pulcherrima : The Gultora Plant 75 to 90 cms. apart. Cut back every year or every other year to form a hedge $1\frac{1}{2}$ to 3 metres high.

Cæsalpinia sepiaria.—The Mysore Thorn. A robust thorny scandent shrub with small leaves and bearing racemes of canary-yellow flowers. It is quick growing and forms a broad dense hedge if pruned regularly. Seeds may be sown *in situ* and the plants may be left 30 to 45 cms. apart.

Carissa carandas.—A large thorny shrub with small oval leaves and white jasmine-like flowers. The fruit is dark purple when ripe. It may be pickled and also used for making tarts and puddings and jelly. Grown from seed. A native

of dry regions of India, Ceylon, and Malaya. The species, *C. Grandiflora*, called The Natal Plum is similar to the above. Plant close together 60 to 90 cms. apart in one line for a hedge.

Casuarina equisetifolia (Casuarinaceæ): Best for sandy soils. Should be planted 22.5 cms. apart and pruned back before a large trunk forms. Its neatness much depends on periodical clipping at every stage of its growth, as otherwise it would soon become stumpy and bare. Best when kept at 1 to 2 metres.

* *Clerodendron inerme*: See under list A.

* *Dodonea viscosa* (Sapindaceæ): Pleasing evergreen shining foliage. A large bushy shrub, drought resistant. Forms a pretty hedge 1 to 1½ metres high, when clipped and kept in order. Raised from seed and planted 30 to 40 cms. apart. May require watering during hot weather.

Duranta: See under list A above.

Furcraea gigantea: Like Agave.

* *Hæmatoxylon campechianum* (Leguminosæ): Known as the Logwood or Campeaching wood. Slender dwarf spiny tree with small shining leaves (red when young) and bearing catkin-like small racemes of highly scented yellow flowers. Stands trimming very well, forming an admirable fence up to 2 metres. Propagated from seeds and by cuttings.

Inga dulcis = *Pithecolobium dulce* (Leguminosæ): Known as the Madras Thorn (Tamil: Korukapuli; Hindi: Belati Imli). Forms a thorny impenetrable hedge 1 to 3 metres high with small dark leaves, if closely planted and trimmed constantly. Plant in two rows 30 cms. apart or put down the seeds 15 cms. apart in two rows.

Jatropha curcasi (Euphorbaceæ): Called the Physic Nut. Forms a quick growing hedge, 1 to 1½ metres high. A drought-resisting common countryside fence. Sow the nuts where plants are growing.

Lantana: See under list A.

Lawsonia alba: Henna. (Canarese: Goranti; Tamil: Marudani; Hindi: Mehnde). Excellent for a screen. Cut down periodically keeping the height from 1 to 2 metres. Sow seeds in a nursery bed. Plant seedlings 45 to 60 cms. apart in a single row.

Pongamia glabra (Leguminosæ) : A medium sized tree, making a good tall hedge, 3 metres high, if planted close and cut back. Sow seeds *in situ* or plant seedlings 60 cms. apart.

* *Polyalthia longifolia* : Sow seeds in trenches where they are wanted to grow. Plant 1 metre apart and keep the hedge 2 to 3 metres.

Punica granatum : The Pomegranate. Planted 60 to 90 cms. apart and kept close by constant trimming, it forms a good hedge $1\frac{1}{2}$ to 2 metres high with pretty foliage and attractive flowers and also fruits. Drought resistant.

Synadenium Grantii (Euphorbiaceæ) : Called the African Milk Bush. Makes a thick fence in a short time by inserting cuttings where they are wanted to grow 30 cms. apart. Keeps evergreen in cool situations. Recommended as boundary hedge for large estates.

Tecoma stans : Planted 60 cms. apart and trimmed to shape forms an attractive screen $1\frac{1}{2}$ to 3 metres high in about 2 years.

Thevetia forms a neat hedge. Plant three rows of seedlings, 22.5 to 30 cms. between each row and plant to plant. Trim sides and top once in three months. After about two years, cut down to 30 cms. or so from ground level as the hedge becomes leafless near the base. Keep the height to about $1\frac{1}{4}$ metre.

Cactus, *Cereus*, and *Opuntia* make good cattle proof fences but they soon outgrow their limits and become a nuisance and so are unfit for home gardens.

Roads, walks and paths in the garden : Every garden has necessarily a carriage drive leading from the entrance to the house or the mansion and to the garage and a few walks and paths which are indispensable to go round and reach the several parts of the garden. If they are too numerous or occupy too much space and are laid out without due regard to artistic principles, they mar the picture of the garden. Especially in small gardens, walks and paths accentuate the smallness of the area. They should be direct and take as far as possible the shortest route to the given points. They should be so planned that one can enjoy the best views of the garden, the house, or some other objects of interest and that

they link up one part of the garden with the other without coming to an abrupt termination. The type of path should be one suited to the position it occupies and the use to which it is put to. It may be made of earth, brick, concrete or be paved. It may be made of firm grass, as a lawn. It may be 'crazy'—a term employed to denote a path paved with blocks of stone with small pockets in between filled with such very low growing spreading plants as Moss Verbena, *Sedum sarmentosum*, white *Alyssum* etc. In formal gardens, as a general rule, straight walks, paths and roads prevail, while in landscape gardens, curved roads, etc., fit best into the picture. The curves should be graceful and easy and each bend should have an obvious meaning. They serve to achieve informality. Long borders would be monotonous but for their wavy and curved edges.

The width of the road is determined by the space available, the size of the house and other considerations. Ordinarily, it varies from 3 to 5 metres. A walk is best laid out with a minimum width of 90 cms. and a maximum of 135 cms. in a large garden. Roads, walks and paths should be well drained or placed a little higher than the surrounding ground with a crowning centre so that water may flow away to the sides. An inclination of one in one hundred would help to drain away water effectively. A solid foundation is necessary or they become slushy and slippery during rainy season.

For making a satisfactory road, excavate the site to a depth of 30 cms. at least. Make the bottom a little convex, that is high in the centre and sloping to the sides. Soak the ground well with water and roll it thoroughly. Upon the firmed ground, closely pack a layer or two of large pieces of stone (metal) or well-burnt brick pieces to a depth of about 22.5 cms. Pour water freely and roll again. Then spread a 7.5 cms. layer of macadam or laterite material or konga (a kind of lime stone). Again sprinkle water freely on top of it and roll well to give a hard road. For making a walk or path, it would do if the soil is removed to a depth of about 22.5 cms. Cover the bottom with a 15 cms. layer of rough stones or brick pieces and roll well. Spread a layer of coarse

gravel, 3 cms. thick. Again roll and cover with a layer of finer material to a depth of 2 cms. or so. Clean white sand spread on a road, walk, or path, kept free from weeds imparts a sense of tidiness to the place. Immediately attend to the repairs of the road, walk, or path should it go bad. Work the part to be repaired with a pickaxe to a depth of 10 cms. water, and pack closely into the space fresh gravel or metal, beat down with a heavy beater and roll well. Keep the roads, etc., free from grass and weeds. Use sodium chlorate solution to kill their roots. Keep the edge of the lawn clean cut with the edging iron if it abuts the walk or road.

Edgings: The term edging is used to denote any material of any description which is employed in gardens for dividing beds, borders, etc., from roads, walks or paths, or for demarcating spaces allotted for particular purposes, as flower beds. An edging may be a live one consisting of dwarf growing plants, handsome in foliage and if possible with flowers too, and capable of being neatly trimmed whenever necessary; or it may be a mechanical one consisting of edging bricks, creosoted boards and so on. Edgings, whether live or mechanical, complete the orderly appearance of a garden.

A grass verge between a bed or border and the road or walk is pleasing to the eye and it further serves as a foil to the brilliant colours beyond it. The grass strip should be kept in good condition by manuring, watering, clipping, and rolling it every now and then. To be effective, it should be about 60 cms. wide. The edge should be clean cut with an edging iron, preventing it from growing and spreading into the road. Edging bricks or iron sheets are often used to save the trouble of having to cut the edge to keep it trim but they are themselves obtrusive.

Mechanical edgings are of various kinds, and they are chosen according to one's requirements. Edging bricks are fixed into the ground in such a way that the rounded edge measuring about 5 cms. is above the ground. Cast iron sheets are less obtrusive. Plain cut-bricks may be put lengthwise, half in and half out. They may also be laid alternately in horizontal and vertical positions for purposes of greater ornament. Rough and irregular stones fixed alongside roads

and paths, with dwarf plants foliage hiding them from view partially form a natural kind of edging in gardens of natural style. Such an edging is common in shade gardens. Bottles, if available in large numbers, as from a brewery or a factory of ærated waters, would form an interesting edging, if plunged neck downwards about two-thirds their length.

Plant edgings should be neatly maintained by trimming them every now and then and by planting fresh plants in place of dead ones. The plants chosen should be hardy, should have lasting foliage, or flowers, or both.

The following are two lists of plants (refer to index also for pages dealing with the plants mentioned below) which are used ordinarily for edging purposes:—

A. Foliage plants suitable for edging:

Alternanthera (Amaranthaceæ): Evergreen perennial herbs, 10 to 25 cms. high, with small handsome leaves, which are variegated differently in different species. They are green and yellow, or bronze and green or red and pink-green. The more handsome species are *A. versicolor*, *A. tricolor*, *A. amabile*, and *A. spathulata*. It is the most popular edging for flower beds and it is also used largely in carpet bedding for 'lettering'. It stands trimming. Cuttings should be planted 3 to 5 cms. apart where they are wanted to grow. The soil should be kept free from cockchafer grubs.

Anthericum elatum variegatum: Grows 15 to 30 cms. Long narrow leaves, variegated cream and green.

Aspidistra: Grows 30 to 45 cms. high with handsome long and broad radical leaves which are green and gracefully arching down. The variegated species with green leaves striped yellow is very pretty. Forms good edging in semi-shady situations along paths and walks. Propagated by division of rootstock.

Caladium Humboldtii: Grows 15 to 40 cms. with small variegated white leaves. Very pretty in shade gardens. Propagated from tubers.

Cineraria maritima: With its silvery grey foliage forms a good edging to *Acalyphas* and such shrubs in shrubbery beds.

Coleus: Dwarf kinds like *C. Hendersonii* growing

20 to 45 cms. high and with pretty coloured leaves form an excellent and broad edging for flower beds or green foliage shrubs and ornamental plants. Raised from cuttings or from seed.

Echeveria (Cotyledon): On hill stations are useful for edging flower beds and rockeries.

Eupatorium cannabinum: Can be trimmed even to 15 cms.

Iresine: Grows 45 to 60 cms., has handsome foliage of either brilliant rose-red or green with rich variegation of yellow; these two species being the most valuable. Can be trimmed to keep bushy. Suitable edging for larger plants in shade gardens.

Justicia gendarusa: Hardy edging which stands heavy rainfall. Can be trimmed to 20 to 30 cms. Thrives in shade.

Phalaris arundinacea: Known as Ribbon Grass or Gardener's Garter. Grows 15 to 30 cms. Pretty leaves striped silvery white. Suited for shade garden. Raised by division of stock.

Pilea muscosa and other species: Grow 7 to 20 cms., have Fern-looking foliage with very small succulent leaves. Spreading habit. Useful as undergrowth in shade gardens and for edging rockeries and to form a verge-like edging. Hardy, thriving in shade, semi-shade and in sun in cool weather.

Pyrethrum aureum: A striking edging to flower beds, 15 to 20 cms. high, with ornamental feathery yellow foliage.

Santolina chamæcyparissus: Suited for edging red foliaged plants and borders in sunny situation. Known as Cotton Lavender. Has small linear leaves. The entire plant which is 30 to 60 cms. high is silvery white.

B. The following are a few floral edgings:

Alyssum; *Amaryllis*; *Brachycome*; *Fairy Rose*, and other miniature Roses also called the Button Rose growing 30 to 45 cms. high and bearing small rose coloured or white flowers of the size of a button; *Gazania splendens*; *Gerbera*; *Lobelia erinus compacta*; *Plumbago capensis*; *Saponaria*; *Torenia*; *Zephyranthes* in species.

Rockery : In this country, the term rockery is associated usually with a large shady tree, a large mound of earth heaped up under it with a number of boulders imbedded in and jutting out of the mound, and a few plants, mostly hardy ferns, peeping through the spaces between the rocks. This kind of erratic structure cannot have any fascination to the real plant lover, as it is utterly devoid of beauty and on the other hand it acts as an effective means of destroying a valuable tree by suffocating its root system.

A real rock or alpine garden, which is well planned and well planted, provides such a variety of interests in a short



Fig. 63
Formation of a rockery.



Fig. 64
Vertical section of a rockery.

compass that it has become an important feature of all modern gardens in temperate and sub-tropical climes. An alpine garden is intended to house a charming collection of alpine plants or plants growing in crevices of rocks on mountain

sides, under conditions and environments approximating to those which obtain in their native homes. Such fine and ideal rock gardens filled with attractive plants naturally growing in mountainous regions covering stone projections or boulders with their neat dainty cushions, tufts, and rosettes of dense foliage and, profusion of brilliantly coloured flowers cannot be achieved in this country except on some hill stations, where only such plants will grow. But, interesting features, called 'rockeries' may be made in gardens in this country with bold rock-work in which are grown dwarf herbaceous bedding plants, very dwarf attractive shrubs, foliage plants and ferns, and succulent plants suited to particular situations, — shady or sunny. These 'rockeries' provide ideal conditions of drainage, aeration of roots and soil moisture for the plant and hence are places where some plants can be seen at their best. Rockeries also serve to dispel the monotony of long flower beds and borders and introduce a new interest and variety into the garden.

A variety of positions may be selected in a wide extent of the grounds for forming a rockery or rockeries. Portions of the grounds, where the soil is too bad or waterlogged or too overpowered by the shade and robbing roots of large trees can be utilised for forming a rockery. So also, rocky situations where boulders present themselves above the surface of the ground. Advantage can be taken of the existence of trees for making isolated rockeries under them. Under groups of trees, rockeries may be constructed, so that a number of kinds of plants differing in requirements of shade and sunshine may be grown on them, those which love a greater degree of sunshine being given sunnier positions than others. In place of a continuous rockery traversing several feet of the grounds, it can be cut up here and there with neat paths, enabling one to inspect all the plants. Along sunny borders or in suitable exposed positions, rockeries may be made and filled with sun-loving plants as varieties of Cactus, Agave, Aloe, Yucca, Kalanchoe and such others. To break the monotony of tiers staged pot plants in conservatories or ferneries, a portion or portions may be allotted in them for a rockery on which are planted diverse handsome plants.

Artificial rockeries are not meant to make a display of several sizes and kinds of stones arranged in fantastic ways. The main idea is to provide an agreeable place for certain plants to grow. The stones of the rock garden give no doubt a characteristic effect but their chief function is to keep cool the roots of plants growing in their pockets and to shelter them and store moisture for their use. Any regularity of plan in the arrangement of rocks should be avoided. It is enough if a sort of rugged effect is produced by the use of stones varying in size and angular projections.

An artificial rockery can be made in the following way. The contour of the intended rockery is marked out on the chosen site and good garden soil enriched with manure and leaf mould is heaped up to the required height and well firmed, by moistening with water and beating with a turf-beater. In place of this soil, the ordinary potting compost can be used. Rocks are then fixed sloping backward into the mound so made, commencing from the edge with larger stones leaving pockets or spaces between the stones for accommodating plants and finishing up with smaller ones. The spaces between the stones should be varied in size to suit growing in them single plants or clumps of plants and plants with large or small root systems. It is necessary that the stones should be firmly fixed in the earth so that, even if a person walks on the rockery, the rocks do not shift from their positions. In a high rockery with a steep slope, the earth is likely to be washed away during rains and hence, it would be advisable to divide it into terraces. Under a large tree as the Banyan or the Rain Tree which spreads its roots along the surface of the ground, the rockery would soon be filled with the roots of the tree making it impossible for the favoured plants to grow. To keep these roots from the rockery, the area selected for the rockery should be dug up to a depth of about 25 cms. and the soil replaced with mortar rubbish saturated with crude oil, or cemented on. Over this hard base, should be spread the compost for constructing the mound.

It is advisable to plant the rockery at the outset only with well established plants. A certain amount of knowledge

of the habits of growth of particular kinds chosen for covering the rockery and a certain amount of taste in allotting them their positions against differently sized stones are necessary. Plants with a pendant habit of growth look graceful against overhanging pieces of rocks. Creeping plants should be allowed to trail along, filling fissures and hiding protruding rocks. Plants of a spreading habit of growth and those which grow forming clumps should be given larger pockets than others. The rockery should be thinly planted to start with. The plants grow and fill the rockery in course of time.

The after care of a rockery, which is thus made and planted, consists in constant weeding, in the prevention of overcrowding by the free use of garden knife, in renewing or top-dressing the soil in the pockets with fresh rich soil, and copious watering in summer or dry weather.

A list of plants suitable for planting rockeries from low to high elevations in India is furnished on the next page and onwards, with remarks on their culture and habits of growth. Refer to index for pages dealing with the plants.

Conservatory : There are numerous kinds of really ornamental plants with beautiful foliage or flowers or both, which cannot thrive in the open, exposed all day long to sun and wind. The delicate Ferns, the graceful Anthuriums and Alocasis, the bright coloured Caladiums, the charming Gloxinias, the wonderful Orchids, the majestic Palms, and several other plants require for healthy and successful culture, a reasonable amount of shade and protection from sun and hot or cold breezes. In tropical gardens, the object of the conservatory or the fernery, as it is popularly known, is to provide and maintain the required shade and the cool atmosphere suitable for such plants. When adorned with specimen foliage and blooming plants, the fernery is an agreeable and enjoyable retreat in hot summer days and serves as a place for entertainment of visitors and friends.

The fernery should face the east or north-east and be protected from the west and south by shade and creepers. If possible, it may adjoin the building or be within easy access from it, in a well kept part of the grounds. The fernery should be so located that plants in it get plenty of light but

PLANTS SUITED FOR ROCKERIES

Name	Situation	Flowering or foliage	Remarks
Achimines	Semi-shade or shade	Flowering	Select only acclimatised hardy species.
Agave	Full sun or semi-shade	Foliage	Agaves, by themselves, without other plants, on extensive fully exposed rockeries are very showy.
Alocasia	Semi-shade or shade	Foliage	
Ananas. (Variegated Pineapple)	Sun or semi-shade	Foliage	
Angelonia cubensis and grandiflora	Sun	Flowers	
Anthericum, varieties of	Semi-shade or shade	Foliage	
Anthurium	Shade	Foliage	

Name	Situation	Flowering or foliage	Remarks
<i>Begonia semperflorens</i>	Semi-shad	Numerous flowers	Thrives in open sun on hill stations.
<i>Belamcanda</i>	Semi-shade	Flowering	Tuberous plant.
<i>Bellis perennis</i>	Semi-shade	Flowering	Thrives in open sun in cool places.
<i>Billbergia</i>	Shade or semi-shade	Foliage and flower	
Cactus species	Sun	Foliage and flowers	Best in open rockeries with other succulents as Agava etc.
<i>Caladium</i>	Semi-shade	Foliage	Select hardy dwarf kinds.
<i>Coleus</i>	Semi-shade	Foliage	Requires light and shade for satisfactory development of colours.
<i>Commelina sellowii</i> = <i>C. nudiflora</i> (commelinaceae)	Semi-shade	Foliage and flowers	Compact creeping perimial

Name	Situation	Flowering or foliage	Remarks
Cooperanthes	Open sun	Flowers	Free flowering than Zephyranthes.
Cotyledon. (Echeveria)	Semi-shade or shade in plains and sun on hills	Foliage	Succulent small plants, with rosette of leaves.
Dracaena Sanderiana	Shade	Foliage	
Euphorbia splendens	Open sun	Flower	Hardy thorny plant, growing without care.
Ferns	Shade and semi-shade	Foliage	Select only hardy kinds.
Fittonia argyroneura and rubro venosa	Shade	Foliage	Ornamental leaved small trailing plants.
Gazania	Open sun	Flowering	Perennial trailing herb with daisy-like flowers.

Name	Situation	Flowering or foliage	Remarks
Herniara (Rupture wort)	Open or shady situation	Foliage	Hardy perennial ornamental leaved trailing herb.
Impatiens Sultani Impatiens Holstii (Hill Balsam). Impatiens repens	Semi-shade. Sun in hill stations	Flowering	I. repens is a creeping herb bearing yellow flowers.
Kalanchoe species	Sun	Flowering	Hardy dwarf undershrubs, spreading.
Lantana Sellowiana and depressa	Sun	Flowering	Hardy perennial with trailing habit, bearing lilac flowers. Propagated from seed.
Linaria cymbalaria. (Ivy leaved Toadflax)	Semi-shade or open sun	Flowering	Stems, small, wiry and trailing; leaves variegated white, pink and green.
Oplismenus (Variegated Panicum)	Shade or semi-shade or sun in hill stations	Foliage	

Name	Situation	Flowering or foliage	Remarks
<i>Oxalis Thesoroidea</i> Rubra	Shade or semi-shade or sun	Foliage and Flowers	Perennial
<i>Pellionia</i>	Semi-shade	Foliage	Creeping herb with roundish oval or heart-shaped leaves.
<i>Peperomia argyreia</i>	Shade	Foliage	Small herb with variegated leaves.
<i>Phalaris arundinacea</i> variegata. (Gardener's Garter: Ribbon Grass)	Sunny or shady position	Foliage	Creeping, spreading herb, 15 cms. high, with fernlike foliage.
<i>Pilea muscosa</i> and others	Partial shade	Foliage	Perennial with crimson flowers.
<i>Portulaca</i>	Open	Flowers	
<i>Rivinia humilis</i>	Semi-shade	Ornamental berries	
Rose "Miniatures"	Sunny	Flowers	In very many pretty varieties.

Name	Situation	Flowering or foliage	Remarks
Ruellia, varieties	Semi-shade	Foliage and flowering kinds	
Saxifraga sarmentosa and some others	Semi-shade	Foliage	
Schismatoglottis	Shade	Foliage	
Sedum (Stone Crop)	Semi-shade	Foliage	
Selaginella, of kinds	Shade	Fernlike foliage	
Setcreasea Purle Heart	Shade or semi-shade	Foliage	Creeping rich purple Fleshy leaves.
Streptocarpus	Shade	Flowering	Dwarf plants.
Torenia asiatica	Sunny	Flowering	
Turnera elegans	Sunny	Flowering	

Name	Situation	Flowering or foliage	Remarks
<i>Tradescantia zebrina</i>	Shade & semi-shade	Foliage	Called Moss Verbena.
<i>Verbena crinoides</i>	Sunny	Flowering	
<i>Vinca</i> (Periwinkle) varieties	Sunny	Flowering	
Violets, <i>Viola Odorata</i>	Semi-shade	Flowering	Creeping perennial.
<i>Vittadenia australis</i>	Sun or semi-shade	Flowering	
<i>Zephyranthes</i> , species of	Sunny	Flowering	

Succulents as Cactii, Agaves, Furcracas Mesembryanthemmus, Phyllocactii, Sansevieras, Yuccas etc., are best by themselves on open rockeries.

The following annuals are suited for 'rockeries' in the open :—Abronia; Alyssum; Ageratum, dwarf; Antirrhinum, dwarfs Rock hybrids; Candytuft, dwarf; Gamiolepis tagets; Hymenatherum tenuifolium; Lobelia; compacta; Nemesia strumosa; Browallia elata; Bellis perennis; Brachycome; Calliopsis, dwarf; Cuphea miniata; Dianthus, dwarf Pinks; Nolana grandiflora; Nicrembergia hippomanica; Phlox, dwarf; Portulaca grandiflora; Salvia splendens, dwarf; Statice sinuata; Tagets signata pumila; Torenia Fournieri; Verbena hybrida; Viola Bicolor (Pansy); Zinnia linearis; Zinnia Haageana and dwarf 'Cupid'.

little direct sunlight. It is not advisable to make a fernhouse under the shade of large trees, as the drip from them damages the plants. The style of the fernhouse should harmonise with that of the building. The simpler it is, the better the creepers display themselves on it. Its size is determined by considerations of available space and the taste and the ability of the owner to maintain a big or a small one. The fernery must be constructed on slightly elevated ground, which is well drained and furnished with a good solid foundation of small stones or broken brick stopped by a layer of firm gritty binding material, which is finished off for effect with a sprinkling of white fine sand. A short masonry wall 75 to 90 cms. high, can with advantage be constructed running round the fernery and enclosing it leaving gaps for entrances. The roofing is supported by stone pillars or iron or concrete posts and may consist of a strong frame work of iron girders and stout iron rods supporting a galvanised wire netting for the creepers to spread upon. To start with, over the framework, is placed a matting made of split bamboo with 2 cms. meshes. Plaited cocoanut leaves may also be used to cover the top of the fernery, for providing shade till the creepers grow and cover the roof. Cocoanut fibre may be used for the same purpose. It is no doubt cheap but it requires to be renewed every year like the plaited leaves. Hanging baskets containing Ferns, Orchids, Asparagus, etc., may be suspended from the roof to beautify the fernery. A small cistern with a fountain playing would contribute to its better enjoyment in addition to being useful in keeping the place cool for the plants. The beauty of the fernery consists largely in the proper arrangement of the plants in it. Tiers of stone slabs or brick masonry are often necessary for the purpose. Where the conservatory is of large dimensions, its interior can be picturesquely laid out. In addition to the tiers or steps for staging plants, rockeries can be constructed in suitable positions, beds could be made for massing ornamental plants, walks can be laid out to enter and emerge out of well arranged groups of plants, and vases and tubs filled with attractive plants be placed in situations where they would catch the eye. The roof and sides should be covered with a quick growing light creeper,

for naturalness and convenience. *Bignonia gracilis* with its bright green leaves and festoons of bright yellow coloured flowers in summer is the most favoured creeper for a fernery.

Of the plants that are usually grown in ferneries, the following are noteworthy:—Several species of Fern, Plam, Aralia and Panax, Alocasia, Anthurium, Cyclanthus, Philodendron, Dieffenbachia, Aglaonema, Dracaena, Heliconia, Alpinia, Hoffmania, Maranta, Rex Begonia, Peperomia, Begonia, Gloxinia, Cineraria, Cyclamen, Orchid, Saint paulia, etc.

Following points demand frequent attention in the care and management of a conservatory:—

(a) The roof should on no account be allowed to be too thickly covered over with creepers. A thin shade is sufficient for a majority of plants. By a judicious pruning of the creepers, the amount of light required for the plants may be well regulated. With too much shade, plants grow weak, long and lanky. On the other hand, should the sun be severe and shading be poor, the leaves of delicate foliage plants get burnt in a short time. A double ladder, $1\frac{1}{2}$ to 2 metres high is well worth possessing as it is very useful for thinning creepers covering the roof.

(b) Plants in the fernery require to be watered with special care. Being in the shade, fernery plants need less water or have to be watered at longer intervals than plants which are in the open. Any plant noticed to be suffering from want of drainage should be promptly repotted. Some plants have their leaves arranged in a particular manner so that the rain water falling on them does not reach the roots; such plants, as Caladiums, should be examined after the rains and watered if need be.

(c) Dust, accumulating on the leaves, should be dislodged by spraying with clear water every day or at least once in three days. This also keeps the atmosphere in the conservatory cool. The plants may also be watered and kept cool in the summer months.

(d) Plants grow in the direction, where they get the light from. To keep them growing erect and symmetrically, without contortions of the stem, they should be turned in their respective positions at suitable intervals.

(e) To keep off hot winds in summer and cold breezes in cold places, the fernery can with advantage be surrounded by tall growing shrubs as *Panaxes* and *Aralias*.

(f) A weak dose of liquid manure made from an oil cake applied alternately with liquid manure made from ammonium sulphate, once in fifteen days, helps to keep the plants in good condition with elegant foliage. Well diluted cattle urine, if available, may be used in place of ammonium sulphate.

Garden adornments : There are several adornments and necessities such as fountains statuettes, garden seats, ornamental posts and pillars, arches, pergolas, trellises basket-plants, plants in tubs and vases, window-boxes embellished with plants, standards, etc., which makes the garden more enjoyable.

Statuettes placed in appropriate situations with artistic taste lend variety, and add charm to any garden.

The playing of a *fountain* is an interesting and arresting sight. The water in the cistern should be kept clean and not converted into a breeding place for mosquitoes. If of large dimensions, the cistern can be made use of to grow aquatic plants as *Nymphaeas*. Some gold and red fish may be reared in the cistern.

No garden would be complete without some *seats*. They should be placed in shady situations facing pleasurable parts of the garden and in ferneries and arbours, where they are most useful. Garden seats are in different types, made of wood, brick, stones, concrete or metal.

Handsome *tubs* and *ornamental vases* and *urns* are utilised to display plants in conspicuous places in the garden. Many attractive plants which would thrive in and adorn borders and beds may not be successful in vases and tubs. Plants have to be chosen so that they are suitable to the various positions in which the tubs, etc., are placed. Tub and vase plants require a lot of attention. As the plants attain growth and the vases or tubs are filled with roots, it is necessary that they should be watered copiously and fed with liquid manure frequently, as they keep on growing in a limited quantity of soil for some years. All decaying leaves, weeds, and spent blooms should be removed regularly. The plants should receive proper staking, when necessary. Tub

plants are very useful for embellishing terraces balustrades, stone steps, etc., in formal gardens. Cordylines, Palms, Crotons, Agaves, Pandanus, etc., make good tub plants.

Plant baskets of different patterns, with suitable plants grown in them and suspended with artistic taste in conservatories, verandahs, corridors, rooms and under shady trees have great ornamental value. Neatly made pots in which attractive plants are grown, can be placed in wire frames and suspended. Hanging baskets are usually made of galvanised wire or wood. The plants chosen for the baskets should by their habit of growth, blooming, and adaptability to cultivation be suitable for culture in them. For single plants for baskets, those which are erect growing and intermediate-sized, with graceful flowing foliage, do well. Plants which are of intermediate or dwarf-growths, and those which droop gracefully, bearing attractive blooms or possessing graceful foliage are excellently fitted for growing in hanging baskets. Sometimes, for greater effect, one may desire to grow different kinds of plants with different habits of growth in the same basket. For instance, a handsome *Dracæna* or a little Palm with recurved foliage may be placed in the centre of the basket and dwarfer plants of a trailing habit as *Tradescantia*, *Fittonia*, *Vittadenia australis*, etc., with beautiful foliage or flowers or both, inserted near the margins so that some of them may gracefully hang down the sides and also display themselves against the cords or wire supports.

It is necessary to prevent the soil in the basket from drying rapidly. For this purpose, the basket is lined with moss or gunny bag or cocoanut fibre cloth, and filled with soil which can hold moisture for sometime. The soil best suited for hanging baskets may be composed of two parts each of leaf-mould, and of rich loam, and one part of horse manure. For tuberous rooted plants as *Freesias*, *Begonias*, etc., some sand should be added to the above mixture. For immediate effects, it is advisable to straight-away plant fairly well developed plants. These can be got ready by starting them from seeds or cuttings and growing them in 10 or 15 cms. pots. It is necessary to see that they are watered regularly. The entire soil should be wetted; it is not enough

if water drips down from certain parts of the basket through the soil. Basket-plants require to be fed with liquid manure as their roots are confined to a small quantity of soil which has to sustain the growth of the plants for quite a long period.

The following are some select plants suited for growing in hanging baskets; refer to index for pages dealing with the plants mentioned below :

Achimenes in varieties ;

Adiantum, (some kinds) ; (fern)

Anemia adiantifolia ; (fern)

Asparagus Sprengeri ;

Asystasia coromandeliana and *Travancoreana* ;

Begonia recumbens ;

Coleus Rehneltianus has a trailing habit ;

Commelina Sellowii ;

Cyrtodeira (= *Episcia*) *fulgens* has pretty foliage consisting of velvety brown leaves and bears bright crimson flowers ;
(*Gesneriacæ*)

Davallia ;

Dracæna with graceful arching foliage ;

Fittonia ;

Freesia ;

Impatiens repens and *Sultani* ;

Ivy Geranium ;

Lobelia ;

Lycopodium lucidulum. (Allied to fern. Known as Jackals' Tails as the tassels of foliage are about 35 cms. long).

Nasturtium, tall kinds ;

Nefrolepis Marshalli and some other kindred ferns ;

Oplismenus Burmanii variegatus ;

Oxalis Thesoroïdes (Firefern) ;

Orchids as *Vanda*, *Phalænopsis*, *Saccolabium*, etc. ;

Palms, young ones ;

Pellionia Daveauana and *pulchra* are creeping herbs with ornamental foliage consisting of roundish oval or heart-shaped leaves, which are olivegreen with white and violet markings ;

Pilea microphylla ; *P. muscosa* ;

Petunia hybrida pendula, known as Balcony Petunias ;

Setcreasea Purple Heart ;

Torenia asiatica ;
Tradescantia zebrina ;
Turnera elegans ;
Verbena ;
Vinca minor and its variegated variety ;
Vittadenia australis, called the Australian Daisy.

Perforated pots and urns filled with good compost and all the openings planted with ferns become very attractive in course of time with a mass of fine foliage. They are ornamental, suspended from branches of shady trees.

Arbours, arches, pergolas and trellises serve as supports to several beautiful climbing plants and to dispel monotony in a level garden. *Arbours* are small cool places of resort in the garden. They are usually open on the sides or they have a lattice work of iron or wood with a roofing covered with elegant climbers. They should be so placed that a good view of the garden may be had from them or they may be placed in a corner so that one may there enjoy quiet, undisturbed. Very often a long walk or the end of a pergola leads to an arbour.

Arches are supports provided for handsome climbers to display themselves. The most suitable positions for arches are over walks. Archways should be at least two metres high and one metre broad. The supports are best made of angle iron of suitable section and firmly fixed into the ground the sides may be composed of galvanised wire netting.

Pergolas are series of connected arches, or in other words archways over walks, and they are quite enjoyable features in large gardens. Elegant climbers, or Grape-vine or Chou-Chou can be grown over the arches making a good show. The frame work may be made of strong supports which are connected together by wood-strips or iron rods. The roof and the sides may be composed of wire netting, for the creepers to spread easily.

Pillars of wood about 2 metres high can be utilised for growing creepers on for effect. The girth of the pillars may be about 30 cms. and they may be covered with wire-netting so that the climbers may go up easily and then gracefully drop down. Pillars are best placed at the junctions of walks in the corners, where they delight the eye.

CHAPTER XIII

WEEDS AND THEIR CONTROL

Weeds may be defined as plants which are not wanted where they are growing. Hariali grass which makes excellent lawns is a troublesome weed in cultivated lands, walks, paths, roads, flower beds, etc. The blue flowering pretty little prostrate plants, *Evolvulus alsinoides* is a weed on a lawn as it is prejudicial to the growth of grass. *Ruellia* and *Turnera* are examples of other beautiful weeds. *Stachytarpheta indica* (Canarese, Uttirani) a common weed, bears blue flowers. *Turnera elegans* and *ulmifolia* are two handsome shrubs which are often cultivated in gardens but they are weeds in uncultivated moist lands. *Eichornia crassipes*, the Water Hyacinth, overspreads large tanks and lakes in a short time rendering them useless. But it is one of the most attractive plants bearing large Hyacinth-like clusters of blue or mauve flowers.

Some weeds have high medicinal value but on that account they should not be encouraged in gardens. The juice of the leaves of *Ageratum conyzoides* which is known as the Goat Weed (Tamil, pum-pillu) is used by villagers for cuts and wounds. The leaves of another common weed *Phyllanthus niruri* (Canarese, 'Kirunalligida'; Tamil 'Keelanalli') are a good stomachic and are used for making cooling oils for baths. Its fresh root is given in jaundice. *Euphorbia pilulifera* (Canarese, akki soppu), the Asthma plant, is useful for making a specific for asthma. *Amaranthus viridis* (Canarese, daggali soppu) is used by the poorer classes as a vegetable green. So also *Oxalis* (Tamil, pulikkerai; Canarese, huliarai).

In agriculture, weeds add enormously to the cost of production of crops. The average cost of tillage to keep down weeds is estimated to equal a twelfth or more, of the value of the crop itself. They are alike the bane of pleasure gardens and homes. *Alternanthera echinata*, for instance, is a prostrate little plant with forking branches, bearing innumerable round thorns, unfitting one to walk with bare legs.

Losses caused by weeds are many :—(1) They compete with crops for plant food, moisture, air and light. (2) They increase the cost of production by increased labour necessary to check them. (3) They increase the cost of preparing crops as food. (4) They impair the quality, destroy or lessen the value of several products. (5) They are the hosts for several kinds of fungus and insect pests destructive to garden plants. For instance, the black leg of Cabbage is spread by the wild Mustard plant. Some wild Leguminous plants are hosts of bacterial germs which bring on blight to cultivated Beans. (6) Some of them are poisonous and may endanger the health or lives of animals and human beings.

For controlling weeds, it is necessary to classify them as annual, biennial and perennial weeds, as they call for different treatment. Best examples of annual weeds are *Ageratum conyzoides*, *Amaranthus spinosus* (Canarese, mullu dantu), *Argemone mexicana*, *Tridax procumbens*. These germinate from seed, grow rapidly; flower, seed in plenty and die, in a season. Perennial weeds do not die completely; they live storing their nourishment in rootstocks, rhizomes or tubers, for active growth under favourable conditions. Such are the *Cyperus rotundus* (Tamil, korai; Canarese, tunge hullu), the Doob Hariali grass, and *Mimosa pudica* (Touch-me-not or Sensitive plant). The principal method of weed control is not to allow them to seed. The old adages, " One year's seed is seven years' weed " and " One year's seeding makes many year's weeding " should be kept in mind by all gardeners. Annual and biennial weeds are best destroyed and kept in check by cutting away their tops. In the case of perennial kinds, top growths come up again and again as they are removed; a repetition of the process every now and then should weaken them ultimately; perennial weeds are best destroyed by digging deep once a year at least, removing them root and branch.

While hand cultivation is the simplest and most efficient means of weed eradication, chemicals are often used to destroy weeds in certain cases, for instance where they are in roads, walks, and paths, far away from cultivated plants. Crankcase oil and dilute sulphuric acid may be used but

they do not kill the roots of perennial weeds. Solutions of sodium chlorate or sodium arsenite applied over the soil reach the roots and destroy them. These chemicals are best applied to kill such weeds as the Hariali, the Nut grass, Bermuda grass, etc. There are other chemicals as carbon-di-sulphide, which when injected into the soil, are absorbed directly by the area of the roots killing the latter.

Sodium chlorate is a dangerous substance, being a fire hazard. It is a vigorous oxidizing agent, setting fire to substances like cotton, wool, straw, etc., which may come into contact with it on application of gentlest heat. It is best dissolved at the rate of $\frac{1}{2}$ to $\frac{3}{4}$ kg. in 5 litres of water and applied to the soil. About 1500 litres may be required for an acre. The solution is safely prepared in metal or earthen containers. Sodium arsenite is a deadly poison. $\frac{1}{2}$ kg. may be dissolved in about 100 to 125 litres of water and used over 835 decemetres. Corrosive sublimate of mercury (bichloride of mercury) is also a good weed killer. 30 grms. dissolved in about 125 litres of water may be used over 835 decemetres. These and other commercial weed killers are poisons and should be used with great caution. Carbon-di-sulphide is a nasty smelling volatile inflammable liquid. It is to be used with care to prevent explosions. Its cost is against its use.

Weeds distribute themselves through manure, rain water, etc. In any programme for exterminating weeds, the co-operation of neighbours is essential in addition to individual efforts.

CHAPTER XIV

ROUTINE OF DUTIES IN A GARDEN

The following are a few of the essential duties which must be undertaken and attended to in order to maintain plants in robust health, to help them to continue flowering, and to give to beds, borders, shrubberies, and in fact to the garden as a whole, that touch of trimness which every garden should possess.

Keep the garden clean. Have the roads, paths, walks and the inside of the conservatories, etc., cleanly swept and strewn with silver-sand for neat appearance. Remove dead branches and twigs from trees, shrubs, and all other plants. Keep the lawn clean by picking dried leaves, etc. Remove weeds wherever they may be found.

Go about the garden and make it a point to visit every section of it at least once a day. The mali's faults of omission and commission and his negligence, if any, will be noticed. Draw the attention of the mali to them to set things right. For instance, a plant might be water-logged and need repotting, another might have been attacked by some insect or disease and need immediate attention to prevent its spread.

Keep a diary for the garden and note therein all the garden operations that are undertaken. This will be a guide for the future operations and will be helpful for knowing to do the right thing at the right time.

Syringe foliage plants with clean water to dislodge the dust accumulated on their foliage. Syringe the plants in the fernery and water the paths, especially in summer, to maintain a cool and fairly moist atmosphere, so much loved by plants.

Pay particular attention to the nursery portion of the garden. Any slight error in sowing the seeds, too great an exposure to severe sun of young seedlings, or slight carelessness in watering them or newly inserted cuttings or layers is certain to bring on failure.

Never water in dribblets; water well or not at all. In summer do the watering in the evening, as during night,

evaporation from the soil is less during the day and thereby plants derive comparatively greater benefit.

Hoe the soil in the beds and borders, etc., before each watering. Never allow the soil to cake or crack.

Thin out superfluous shoots from plants retaining only those which are really useful.

Thin the buds if necessary. This is necessary in the case of a number of kinds of plants. Carnations, Dahlias, Chrysanthemums, etc., carry three to four or more buds close together; remove all but the largest in each bunch, if large flowers are required; and the earlier the disbudding is done, the better, as this saves the strength of the plant from being wasted on unwanted growth.

Stake the plants which require support to prevent them from being blown over; do not bunch the growths together untidily by running the string round them; loop them loosely up to a central stake. For tying, pass a wet plantain-thread or any other tying material like raffia thread, around the stake, bring the two ends towards the shoot to be secured, at the same time cross them, then pass them around the shoot and tie the knot.

Protect shade-loving plants from severe sun by keeping them under a tree or in the plant house or in the verandah getting morning sun. Shelter them from too strong a wind by providing them with suitable screens, whenever necessary.

Watch carefully against insect and fungoid pests and take prompt measures to eradicate them. Examine the soil occasionally — especially that of pot plants — for cockchafer grubs which have to be picked and destroyed.

Verandah and window-plants and those in conservatories getting a greater degree of light from one direction than another have a tendency to grow towards the direction of intense light. Hence, for ensuring uniform growth on all sides of the plants, turn them in their positions once in ten days.

Keep garden implements always clean and bright and store them in a shed or any other suitable place when they are not wanted. Do not throw them all about the garden to be searched for, each time they are wanted for use.

To keep the garden going all the year round and to

secure the best possible results, you must look ahead, think out your requirements, and get them ready in proper time. Seeds should be obtained for sowing in the right time ; beds should be dug up and the soil exposed for at least a fortnight to sun and air before they are refilled with plants ; pits should be got ready at least a month and a half before plants are planted in them ; composts for pot plants should be at least a month old before they can be safely used ; bulbs should be taken out of the soil in right time and stored in a cool place till they are potted or planted out again ; shrubs and plants which need to be pruned, should be pruned at the proper time and so on.



ORCHID. PHALAENOPSIS SCHILLERIANA
IN A HANGING BASKET



SOME ROCKERY PLANTS:—Top: *Anthericum*, *Phalaris arundinacea* variegata, *Selaginella*. Bottom: *Sedum reptans*, *Selaginella*, *Anthericum*.



SOME MORE ROCKERY PLANTS. Top: *Drimys pinnatifida*, *Fittonia*.

CHAPTER XV

FLOWER SHOWS

Rapid progress has been made in horticulture in this country due to the work of some horticultural societies. Flower Shows and Garden Competitions held under the auspices of these societies stimulate the interest of the public in gardening and encourage all people to form and maintain gardens. Garden Competitions have been responsible for many lovely gardens springing up round many a bare house and for the popularisation of many a charming plant. Flower Shows in which flower plants in pots are exhibited, as also cut flowers, vegetables and fruits, afford the public, plenty of opportunities to observe and note at one time all the best material available for embellishing gardens, for exchanging ideas about culture of several kinds of plants, and for observing the degree of success that could be achieved in the cultivation of particular kinds. It is the desire of many an amateur to show his plants and products of his garden in the Agri-Horticultural Shows but he is diffident of winning prizes as he is afraid that persons with greater experience and who he believes know the technique of growing and showing plants better than himself will walk away with the prizes. The following tips may be helpful to embolden amateurs to try their might at the shows.

Collections of annuals, herbaceous perennials and handsome flowering shrubs and creepers and foliage plants as Crotons, Dracænas, Palms, Ferns, Caladiums etc., are offered prizes. These should be grown in such a way that they are at their best on the day of the show. First, regarding annuals:—Secure seeds of best quality from recognised firms, in time, at least a fortnight or a month before sowing. Sow the seeds thinly in seed-pans so many days before the blooms are wanted according to the time each variety takes. Sow seeds not all at one time but at intervals of three or four days, twice or thrice, to save disappointments due to damping off or miscalculations in the time of showing. Prick seedlings as soon

as ready and pot or bed them out when they touch each other, Give them as much sun as they can reasonably bear. Pinch the shoots to bush them out. Keep only a few shoots, if large flowers are required. Stake the plants from the very beginning. For large flowers, freely remove all side buds keeping one or two only in a cluster in such kinds as Carnations etc. Feed the plants with liquid manure once a week from the time flower buds are formed. Do not allow the plants to bloom till good specimens of plants are formed. Keep on removing buds should they appear earlier than required. Do not grow more than one variety in a pot. Do not mix several colours in a pot. As for instance, in Phlox, grow them in separate colours. Do not grow plants in pots too big for them. Choose the proper size of pots and do not allow the plants to get lost in the pot. Unless the kind permits of more than one plant being grown in a pot as in Phlox, as far as possible grow only one plant in a pot and bush it out to fill the entire pot by frequent pinching of the shoots. For this purpose, seed sowing will have to be started earlier than otherwise. Grow more plants than are actually required for the purpose of showing, for there may be many failures, many may not bloom in time.

Next, regarding prennial plants:— Grow them from cuttings or layers or from seeds as mentioned above for annuals, using the same care in transplanting, feeding, providing sun and air, staking, pinching back, and disbudding, etc.

Regarding shrubs:— Re-pot them once or twice a year, with three or four tablespoonfuls of bonemeal for each large pot containing the shrub. After potting, wait for the sap to rise to the required height and so time the pruning that you can reasonably expect the blooms on the day of the show.

Regarding foliage plants as Palms, Crotons, Dracænas etc., syringe them with clear water once at least every other day and feed them with liquid manure prepared from oil cake once in 20 days.

All show plants should be stocky and strong and this is ensured, only if they are properly fed with doses of liquid manure and are grown giving them the fullest amount of sun that they can bear without injuring the foliage.

A few observations on taking plants to the show are necessary. Take always a few more than the required number, as some of them may get damaged in transit or may not fit in while grouping. Stake them suitably so that they may not brush against each other and get damaged in foliage and flowers. Clean the pots well, scrubbing them on the outside with cocoanut fibre brush. Remove the dust and dirt from the foliage by sponging or spraying with clear water. Remove all faded or old flowers and diseased leaves. Cut away shoots without blooms, if necessary to show off the blooms in others. Do not make the staking obtrusive. Do not artificially prop up flowers, in case of such species which really do not need to be staked. When the show prospectus says that only pot grown plants are to be shown, do not attempt to hoodwink the judges by lifting the plants a day or two before the show and potting them using a top layer of compost. Pot grown plants can be easily distinguished from those lifted from the ground. Take to the show only those collections of yours which in your honest opinion deserve first prizes. Keep good watch over your plants, for in all shows there are always busy-bodies attempting to steal or damage your plants. Put a mark on your pots to enable you to spot them out when missed. If not, you will often find your plant in the next entry, without being able to claim it successfully as yours. Label the plants in a simple unobtrusive way. Write the names, clearly and legibly, with an ink that does not blur.

About staging exhibits :— Take care you do not shove in more than the number of pots required under the rules. Let the varieties shown by you in any kind of plant be distinct. You cannot expect the judges to inspect your plants with a microscopic eye for finding out differences. Marks are usually allotted for staging, varieties shown and cultivation. Do not overcrowd your plants while staging. As far as possible, let each plant stand out well, its individual merits capable of being studied. In a group, the plants should harmonise with each other in the colour scheme and also with the background. Deep colours should be broken up by placing by them whites, cream, or ivory and such ones. Distinct colours should be

placed farther apart to enable counting to be done easily. Let not the colour of the background obtrude. For this purpose, have such colours as light yellows, pinks and whites immediately next to a black background. If it is white, let the contact colours be scarlets, crimsons, purples and blues. The plants should dovetail into each other; then only will the staging be effective. Do not mix up large plants in big pots with small specimens in smaller pots, as the latter would get lost in the group. However rare a variety may be, do not put it up if it is not well grown, as it will spoil the effect of an otherwise good group. Generally, it is the excellence of the plants, the blooms and the effectiveness of the group as a whole that impress the judges and not a few extra number of varieties.

Regarding cut flowers:— The blooms should be of good shape, large, and fresh. They are the result of feeding the plant with liquid manures and disbudding. Coarse flowers without good form do not win prizes though they may be large in size. While arranging flowers in a vase, too many should not be huddled together. Again, clashing colours as purples and scarlets should not be put into the same vase. It is best to show flowers with their own foliage. Keep them in water or wrap them in tissue paper when you take them to the show hall. If they fade, dip the ends of the stalks in hot water for a few minutes and after cutting off half to an inch, keep them in water containing a pinch of salt or aspirin. This helps them to keep fresh longer than otherwise.

CHAPTER XVI

PACKING AND EXPORTING OF PLANTS AND CARE OF NEWLY RECEIVED PLANTS

Plants, flowers and seeds have to be carefully packed so that they may reach the destination safely. The kind of packing depends upon the plants themselves, the distance they have to travel and the mode of conveyance.

Plants which have to be sent to comparatively short distances, necessitating a travel of two or three days only, are first watered and then taken out of the pots or carefully dug out of the ground, with the balls of earth holding the roots intact, which are rapped in straw and firmly tied round and then soaked in water; such balls of earth so tied up, are then placed in a bamboo matted basket, stakes and extra straw being used to fix them up firmly in the basket without being tossed about; into the holes made on the sides of the basket are thrust long strips of split bamboo which are bent over and tied above the basket forming a sort of balloon; strong thread is tied over the plants from the edges of the basket holding them down. The balloon is finally enclosed in a mattress of palm leaves or gunny bag.

When the plants have to travel for seven to ten days, the balls of earth are after being soaked through with water, covered first with a thick layer of moss and then with cocoanut fibre or polythene paper. The wet moss prevents evaporation of moisture from the earth for some days. Care is to be taken that only plants which have a well developed root system are selected for sending out. The plants are taken out of the pots or ground and left in moist sand for 20-30 days with their balls of earth immersed in it. Only the plants which remain fresh after the said period are exported, as they alone can be depended upon to stand the strain of the journey.

When the plants have to be sent over very long distances, the journey taking several days to complete, the balls of earth

packed in moss and covered with Polythene bags as described above are put into boxes (Wardian cases) with a layer of moist sand or saw dust to prevent evaporation as far as possible. Two holes are made at the top of the box for ventilation.

Hardy deciduous plants as apples, pears, peaches, vine, etc., are imported from distant places as from Australia. They are pulled out of the ground without injuring the roots; these are covered with moist moss and covered with Polythene bags, the leaves are removed and the plants are bundled up like sticks and packed in large deal wood boxes. The plant sap is driven to the root, where it is stored and preserved. Deciduous plants and plants like Orchids are best despatched when they are resting or are least active in growth. Bulbs, rhizomes, tubers, corms, and such underground stemmed plants are best sent, like potatoes, when they are resting.

As soon as a consignment is received, it is opened in a cool and shady place and the plants are taken out carefully one by one. If the plants have no balls of earth attached to the roots as in apples and roses, the roots are dipped in a paste of clay and cow-dung water. The plants are then potted in a light porous compost, made up of 1 part of red earth, 2 parts of sand, 2 parts of leaf mould, and 1 part of spent manure. Before potting, all dead and diseased roots are clean cut back to healthy portions. The stems are likewise cut back to healthy parts, if they have died back. The pots are removed to a cool and shady place and watered with care; they are not to suffer for want of water, but at the same time, overwatering is avoided. The buds swell and grow into shoots, when the plants are gradually hardened by exposing them to more and more sun daily. If the plants are received with their balls of earth round the roots, they are moistened with water, the wrapping material is removed and the plants carefully potted in the soil recommended above and taken care of in the same way. If the ball of earth consists of hard clay, it is advisable to break it and pot the plant, if the weather is cool and rainy. If the weather is hot, the balls of earth may be cracked by pressure and the plants put in sand for a few days in shade to induce the roots to push through the shell of hard clay, after which the plants may be potted in suitable compost.

PART II

Select Plants for the
Garden

CHAPTER XVII

TREES

A judicious planting of trees contributes much to the beauty, variety and the enjoyable features of gardens and pleasure grounds. Trees afford shelter and shade and make summer time not unpleasant. Many are ornamental, beautiful in bloom or in outline or foliage. Some fill the air with the delicious fragrance of their flowers. Some provide fruits. Almost all of them delight and refresh the eye with their restful green foliage. Along with shrubs, they form the frame-work of garden and being permanent, easy to grow and requiring very little attention, no garden of any pretension to size should be without them. According to the purpose they are grown, they are allotted suitable places in the garden. It is inadvisable to crowd them round the house cutting off light and air or plant them where they overshadow places which could be utilised better. Where room is wanted for growing flowers or vegetables, trees are not to be planted.

Only such hardy trees which thrive under the particular climatic and soil conditions should be grown. As trees are permanent fixtures in the garden, the ground should be well prepared for planting them. (See Chapter VII for instructions on planting trees, and Chapter X for instructions for pruning them). They should be protected by tree guards from mischief by cattle or injury through any other source.

Sometimes, branches are torn off by wind or are badly cut by unskilled *malis*, with the result that decay soon sets in and big cavities are formed in the stem or the limbs, on account of the injuries sustained by them. Unless protected from further decay, the trees would get attacked by dangerous parastic fungi and die in course of time. The decay may be prevented and the health of a tree restored thus :—All decayed wood is cut or scraped out and removed from the interior of the cavity, which is then well washed with an antiseptic, such as a solution of mercuric chloride (corrosive sublimate) or copper sulphate and lime. The edges of the cavity are also

cut smooth so that the cambium may grow freely and cover the cavity after it is filled. It is necessary for the success of the operation that the cavity should be completely filled, entirely excluding air. This is done by pouring and pressing into the opening a mixture of concrete and cement of such a consistency as will fill every nook and corner of the cavity. The finished surface of the filling should terminate with the edge of the cambium for it to grow and cover the surface rapidly.

Trees are either deciduous or evergreen. Deciduous kinds generally produce their blooms when they have shed their leaves or just after or are being clothed with fresh foliage. In India, the period between February and June is remarkable for the flush of bloom of many of the trees. Some trees, however, flower in August and September during the rains. Again, there are many, which flower intermittently throughout the year. A due proportion of the flowering trees selected in such a way that one or the other of them, is in flower throughout the year, is very much to be desired.

For purposes of convenience, trees are treated and grouped under three headings in this book:—(A) Select flowering trees, which are grown for their beautiful or fragrant flowers, (B) Ornamental foliage trees, mainly grown for the richness and attractiveness of their foliage or form or both, and (C) Shade trees, which are grown for their shade. Only trees which are suitable for private gardens are considered.

(A) SELECT FLOWERING TREES

Acacia: (*Leguminosae*) The following species of *Acacia* thrive only in upcountry. All of them are very ornamental.

**A. longifolia*: Known as Sydney Golden Wattle. Small spreading tree with pale yellow flowers borne in February-March and again in July to August. Very ornamental.

**A. pycnantha*: Known as the Golden Wattle. Medium sized very ornamental tree while in bloom in the dry season, bearing masses of yellow blossoms. A native of South Australia.

A. dealbata : Known as Silver Wattle. A small Australian tree with finely cut leaves, the underside of which is silvery white. Large heads of yellow blossoms are produced in February–March and in July–August, when the tree is very showy. Propagated from suckers which it throws out in plenty or from seed.

A. decurrens : Known as the Black or Common Wattle. A large quick growing tree, introduced from Australia producing fragrant yellow flowers in the dry months.

A. elata : Known as Cedar Wattle. Attractive species with feathery drooping foliage and large, pale yellow inflorescence.

A. Baileyana grows 3 to 4 metres is very much like *A. dealbata* and bear long sprays of rich yellow flowers.

A. cultiformis is another handsome species.

A. casia moniliformis : Tall Australian evergreen tree. Leaves are like those of Eucalyptus but without midrib. The flowers are pretty yellow catkins diffusing pleasant odour.

Amheprstia nobilis : (*Leguminosae*) : Named after Lady Amherst, wife of a former Governor of Burma. One of the most ornamental and beautiful flowering trees. Called by some, the “Queen of flowering trees”. Of very slow habit of growth, allied to *Saraca* and *Brownea* and attaining a height of about $4\frac{1}{2}$ metres in Bangalore, though it is reported to reach 10-15 metres in its native home in Burma. The young leaves which are of a light purplish coppery hue are folded and clustered into long flaccid bunches gracefully hanging down the tips of the branches. Mature leaves are large, dark green, and paripinnate with 6-8 pairs of leaflets. As many as twenty flowers are borne in very long loose drooping vermilion coloured racemes, measuring 50-60 cms. in length, supported by a slender thread of the same colour, hanging down from the axils of leaves. Each individual flower is about 15 cms. long and is made up of a vermilion coloured peduncle which is nearly 7.5 cms. in length, two very brightly coloured petal-like large bracts and five petals, of which two are small and the others are large, red and tipped with yellow. The stamens, which are of the same colour as the petals are united at the base forming a keel, in which is lodged the style. The keel

branches off into five crimson filaments, each of which carries a dark coloured anther. The tree presents a glorious and a striking aspect with its brightly coloured pendulous racemes of flowers and its finely coloured bunches of tender leaves gracefully hanging down the tips of almost every shoot all over the tree. The tree is in bloom for the greater part of the year but it is particularly attractive between April and May. The pods are broad, flat and crimson in colour. Seeds are mostly sterile. Propagated by layering or gootying. The tree is rare but it can be got from Calcutta; and it is well worth introducing into our gardens. It thrives at low to medium elevations in places where there is a good rainfall but it does not seem to thrive near the sea. Young plants die soon unless they receive particular attention to cultivation.

Barringtonia. (*Mrytaceae*). *B. speciosa* (showy) : Very ornamental, medium sized, spreading, evergreen tree, with handsome foliage, consisting of large leathery shining leaves and bearing great heads of blossom, composed of large flowers, made up of numerous long deep rose coloured filaments. Propagated from seed, by layers, and from cuttings with leaf attached. Allied to the common Rose-apple tree. Native of Burma, Malay Archipelago.

B. acutangula is superior to the above species.

B. racemosa is another attractive species. It is a large tree, a native of Malabar, very showy when in bloom, with its very long pendulous racemes of pinkish flowers. All the above species love moisture.

Bauhinia. (*Leguminosae*) : Hindi, Kuchnar. Named in honour of John and Caspar Bauhin, twin-brother botanists of the 16th century. Bauhinia is an extensive genus of shrubs and small trees, several of them being indigenous to India. Some species are really very ornamental, deserving prominent places in the garden. Members of this genus have characteristic leaves, having the appearance of a camel's foot, being composed of two similar oval leaflets laid side by side and united beyond the middle. The flowers, which in many species are fragrant, are borne plentifully. Propagated from seeds easily.

The following species deserve special mention :—

* *B. monandra* is a deciduous tree, 3 to 4 metres high, bearing very pretty pink flowers having dots and splashes of red and orange. One of the prettiest species. Similar to *B. variegata*.

* *B. variegata* (Canarese: "Kanchivala"; Tamil: "Mantharai"; Hindi: "Kuchnar") is a middle sized deciduous tree, a very common in Malabar. Flowers are large, white, variegated with rose, purple and white and borne in leafless condition.

B. purpurea is a fairly good sized tree, bearing showy fragrant flowers of a purplish-rose colour.

* *B. alba* grows $2\frac{1}{2}$ to 4 metres high, with large white flowers.

* *B. candida* is a very beautiful small tree or a large shrub, bearing pure white, sweet scented flowers in great profusion. Grows 2 to 3 metres.

B. tomentosa (Canarese: "Vanasampige"; Tamil: "Thiruvatti") is a small tree or a large shrub, 2 to 3 metres high, constantly in blossom with beautiful sulphur yellow flowers with a dark purple centre. The colour changes to copper-yellow as it fades. The flowers are used for puja and hence the tree is commonly grown by Hindu temples and gardens.

B. Hookeri is a tall tree from Australia with white flowers.

Bignonia. (*Bignoniaceae*): This genus which includes such excellent climbers as *B. gracilis*, *B. venusta*, includes some very handsome trees also:—

B. crispa: (Tamil: "Padiri") is a handsome tree with drooping long branches and shining foliage, bearing erect, pearly-white, crisp edged, funnel-shaped, delicately perfumed pretty flowers, largely used in Hindu temples. Propagated by offsets.

B. megapotamica: Known as the Rio Grande Trumpet flower tree, is a handsome deciduous tree, 5 to 10 metres high, with branches gracefully sweeping the ground. Foliage consists of bright, olivegreen, compound leaves with three or five leaflets. Pretty, light pink flowers are produced in plenty in March and April. They are clustered in terminal bunches on

almost every shoot on the tree. The corolla is tubular with five lobes, which are frilled and thin. The tree is a good subject for a lawn or a small avenue. Propagated from seed. A native of Brazil.

B. undulata is a small tree, having loose spreading branches and narrow undulating leaves. It is attractive in March and April, when it bears racemes of large, erect, yellow or orange coloured flowers, which are attached close to the younger parts of the stem.

Bombax malabaricum. (*Bombacæ*): An upright tall very large quick-growing deciduous tree with candlebralike branches. A native of India, Burma and Ceylon. Called the "Silk Cotton Tree" or "Red Cotton Tree" on account of the silky floss discharged by the fruit pods which is used for stuffing pillows, cushions, etc. In January–February, when the tree is quite leafless, it is striking with large bright red flowers clustered on its branches. The flowers, which are fleshy and edible, carpet the ground, as they drop, for nearly three weeks. The straight trunk may be used as a good support for training climbers.

* **Brassaia actinophylla.** (*Araliaceæ*): Known as the "Umbrella Tree." A small but erect growing tree, about 7 metres high, having very few branches. Foliage is evergreen and consists of large radially divided leaves. Flowers are remarkable and are borne in brilliant scarlet or coral-red, terminal radiating spikes, measuring 30 to 60 cms. in length. The tree very much improves in appearance, if headed back once in three years.

Brownea. (*Leguminosæ*): The Browneas introduced from Central America and Trinidad, are very ornamental, very slow growing garden trees, bearing large clusters of rose or crimson flowers from the axils of leaves. The leaves are flaccid when young. As a class, the trees deserve to be made popular. They are usually propagated from seeds, from which they take 10–12 years to bloom. Following are noteworthy species:—

* *B. grandiceps* is probably the best of the Browneas. It is a very handsome medium-sized evergreen tree with characteristic foliage and bright red flowers clustered in large dense

round heads, borne at the ends of long and gracefully drooping branches. The foliage when young is very handsome, being produced in long drooping flaccid bunches, having coppery-pinkish hue, as in *Amherstia* and *Saraca*. Flowers are borne in April and May.

B. coccinea is of a somewhat dwarf spreading habit of growth, producing scarlet flowers.

* *B. ariza* is a small tree; bears in February–April from the ends of the branches large compact clusters of bright rosy scarlet flowers.

Bursaria spinosa. (*Pittosporaceæ*): A handsome, evergreen, medium sized tree, 4 to 7 metres high, introduced from Australia. Has an upright, much branched, compact habit of growth. Flowers are creamy white, small fragrant and borne either in terminal or lateral panicles. The tree is a charming object from November to January, when it is covered all over with the elegant white blossoms. Easily grown from seed.

Butea frondosa. (*Leguminosæ*): (Canarese: "Muthuga"; Tamil: "Palasu"; Hindi: "Dhak"). A moderate sized deciduous forest tree of India, unattractive, when not in bloom, on account of its crooked and distorted stem. Leaves are pinnately-trifoliate and are used by the Hindus during religious functions and are stitched together to form plates to eat from, which are used all over India. The tree is gorgeous in bloom, in February–March, when it is leafless, bearing in great profusion vivid orange-crimson flowers in large showy dense racemes; hence, it is planted in large gardens near the confines, where it is striking in bloom. Economically, the tree is valuable; the lac insect thrives on its branches; the flowers produce a temporary dye; the tree provides the Bengal kino gum, which is largely used in tanning operations and in medicine.

* ***Callicarpa lanata.*** (*Verbenaceæ*): A small tree, native of the Western Ghats, 2½ to 3 metres high. Very pretty producing between August and November umbels of charming purplish flowers, which are small and are followed by very ornamental white berries. *C. americana* is a later introduction, also pretty.

Callistemon. (*Myrtaceæ*): * *C. lanceolatus* (Syn. *Citrinus*)

is the well known Bottle-brush Tree. *Callistemon* is derived from two words, meaning the beauty of the stamens, as in most of the species the stamens are brightly coloured, usually scarlet. It is a small erect growing Australian tree with a neat habit of growth. It is well worth introducing into our gardens, for the neatness of its foliage which consists of narrow stiff lanceolate aromatic leaves and the beauty of its blossoms. It is very beautiful in April, with its bottle-brush-like crowded cylindrical spikes of brilliant crimson-scarlet flowers with their free stamens, produced on the old branches. The tree sometimes flowers in August–September also. Suitable for planting on lawns. Propagated from seeds which are very small or by layers.

C. brachyandrus is suitable for medium to high elevations and bears yellow flowers.

Calophyllum inophyllum. (*Guttiferae*): (Canarese: 'Sura-binne'; Tamil: 'Pinnae'; Hindi: 'Sultana champa'). The name *Calophyllum* is expressive of the beautiful leaf; *kalos*, beautiful, and *phyllon*, a leaf. A beautiful large but very slow growing evergreen tree, with noble foliage of dark green polished leaves, resembling those of *Magnolia*. Large racemes of delightfully fragrant white flowers are borne in May–June. These are succeeded by round fruits of the size of a lemon. Raised from seed. Called by some The Alexandrian Laurel. Called also the "Dilo oil" Tree, after the oil from fruits.

C. spectabile is another handsome species.

Canarium odoratum. (*Anonaceae*): "The Ylang". A tall, quick growing tree with horizontal branches arching down at the ends, giving the tree a stately appearance. Flowers are borne freely, very fragrant, greenish yellow, and they resemble those of *Artabotrys odoratissimus*. From them, Cananga-oil water or Ylang Ylang of Japan is made. The tree is hardy and thrives in any good garden soil. Easily raised from seed.

Cassia. (*Leguminosae*): A large genus comprising of some very ornamental trees and shrubs. Almost all of them are quick growing and easy of culture. They are mostly deciduous and some of them are in full bloom when they have shed their leaves. Their long blooming period make them

valuable additions to the garden. Propagated from seed. Variations often occur in colour and habit from the parent in seedling plants. The following species are of especial merit:—

* *Cassia fistula* : (Canarese : 'Kakke' ; Tamil : 'Sarak-konne' ; Hindi : 'Amaltas'). A very useful medium-sized beautiful tree of very slow growth. Common in Indian forests and has names in almost all the vernaculars. To the Europeans, it is known as the "Indian Laburnum" or the "Golden Shower". The tree is an imposing sight when in bloom, in February–May the whole tree being enveloped in a mass of large, long, lax, pendulous racemes of bright yellow flowers, which have a delicate fragrance. Flowers are succeeded by long cylindrical pods which become black when ripe. The foliage consisting of pinnate leaves appears only after the flowers are finished. The seeds and the bark of the tree are used in medicine and in dyeing. Propagated from seeds and also from suckers arising from the roots. Young plants are delicate and do not stand transplanting well.

* *Cassia multijuga*. (Syn. *Cassia calliantha*) : A slender fairly quick growing small spreading tree, with leaves smaller than other Cassias. A native of Tropical America. Very beautiful when in bloom with its erect large racemes of very bright yellow flowers which are very freely borne absolutely covering the tree with a mass of gorgeous colour. It can be propagated with difficulty from cuttings and easily from seeds, which are produced only in dry regions. Blooms late in the season in August–September. Suited to moderately dry regions.

Cassia grandis (great) : Called by some "Horse cassia" and by some others the "Pink shower", is a spreading, elegant, quick growing tree, bearing a profusion of salmon-pink flowers, in abundant erect ladder-like racemes from the axils of fallen leaves, during the months of March and April. As the flowers fade, new shoots appear covering the tree with rich foliage of pinnate leaves, which are about 20 cms. in length. The pods are about 30 cms. in length, $2\frac{1}{2}$ cms. in thickness, rough and woody.

* *Cassia renigera* : A middle sized deciduous tree with handsome erect habit of growth. Flowers are bright pink or

light rose coloured and they are borne, collected in racemes, from the axils of all the fallen leaves, all along the branches, giving the appearance of long erect sprays. The tree is entirely free from foliage when in full bloom in April-May, when it affords one of the grandest floral sights. This tree, which was rather rare, is now planted in almost every garden in Bangalore on account of its great beauty when in full bloom and is tried with success in Madras and farther south also. A hybrid of *C. renigera* which partakes of the characteristics of *C. renigera* *C. nodosa*, in bearing long sprays of *C. nodosa*-like flowers is very familiarly met.

Cassia nodosa. (Pink Cassia): A moderate sized deciduous tree with a spreading habit of growth, the branches being long and drooping and richly covered with green bi-compound arching leaves. Flowers are rose-pink in colour and they are clustered in short, dense, round racemes, borne in the axils of leaves or above the scars of the fallen leaves. This tree is attractive with its fresh foliage interspersed with its bunches of flowers in April-May.

* *Cassia javanica* is another very handsome quick-growing Cassia. It has the most ornamental habit of growth among the Cassias. The tree grows tall like the *C. renigera* and its branches are long and wavy and gracefully arch down. The blooms come up with the foliage in April-May and it appears as though out of every compound leaf, the terminal leaflet is transformed into a flower bunch. The bunches of rose-pink flowers seated erect on the branches for a greater part of their length with the foliage, give the tree really an ornamental appearance, peculiarly its own.

Cassia marginata (Syn. *C. Roxburghii*) (Tamil: 'Vakai'): A very graceful medium-sized Indian tree with neat a habit of growth, with spreading and drooping boughs, which appear overweighted with their wealth of clustering bloom, produced in April-June and also in August-September. The foliage is pretty consisting of alternate pinnate leaves of 10 to 12 pairs of linear-oblong leaflets, about 2.5 cms. in length and 1 cm. broad and having the margins coloured, from which fact the name is derived.

Hybrid varieties of *Cassia marginata* varying in the shades

of the colours of flowers from deep rose, brick red to those of *C. marginata*, with a more erect habit of growth than the latter and bearing erect beautiful sprays of bloom as in *C. renigera* are seen in Bangalore in several gardens. These trees are very beautiful when in full bloom with their foliage setting off the colour of blooms. Easily raised from seed. Called by many *C. marginata* variety *grandiflora* on account of the grand appearance of the flowers.

C. moschata leaves lovely hanging apricot flowers.

Castanospermum australe. (*Leguminosæ*): Known as the Moreton Bay Chestnut Tree". A large slow growing moderate sized evergreen tree, introduced from Australia. It has an upright habit of growth with pretty foliage of pinnate leaves of about nine broad smooth entire leaflets. The tree bears, in the month of March, axillary or lateral loose racemes, composed of pretty, large, orange-crimson flowers. Two to four large chestnut-like seeds are enclosed in stout brown pods, which are produced in plenty. The seeds are reported to be edible though astringent.

Cerbera odollum. (*Apocynaceæ*): (Tamil: 'Kattarali'). A native of the salty swamps and backwaters of the East and West Coast of India and Ceylon. A middle-sized evergreen tree with shining, lanceolate, bright green leaves, bearing large cymes of odorous pure white flowers resembling those of *Plumeria Lambertiana*. The tree is in bloom throughout the year. The flowers are succeeded by poisonous fruits. The tree has a much branching habit, so much so that the lower branches come down and gracefully sweep the ground.

Citharexylon quadrangulare. (*Verbenaceæ*): Popularly known as the Fiddle Wood Tree. An upright deciduous tree, introduced from West Indies about 7 metres high, with dark green foliage of fairly large leaves. The tree looks bare and ugly when it has shed its leaves. It bears in March-May and during the rains and occasionally at other times of the year too, drooping racemes, 7.5 to 15 cms. long, composed of numerous small very pleasantly scented white flowers. The branches of old stumpy trees may with advantage be cut back once in three years for fresh vigorous growths which are clothed with pleasing foliage. Propagated easily from long

cuttings, inserted where they are wanted to grow. Every garden should have this tree for the delicate scent of its flowers which pervades the atmosphere for a long distance from it.

* *C. fruticosum* is a dwarf species with flowers more highly scented.

Clusia rosea. (*Guttiferae*): Commonly known as the "Balsam Tree". A native of West Carolina. A very slow-growing, spreading, medium-sized, evergreen tree. Leaves are spathula-shaped, bright, polished green, and Magnolia-like. Flowers have a resemblance to those of Magnolia, are large and fleshy white with a large rose coloured centre and conspicuous sticky stigma projecting a little outside the centre. Propagated from seed and by suckers produced near the tree. Blooming period is from March to May.

* **Cochlospermum gossypium.** (*Bixaceae*): (Canarese: "Arasina burugada mara"). The "Yellow Silk Cotton Tree". A medium-sized indigenous deciduous tree, with three or five-lobed leaves, unattractive when not in bloom. But, in the hot season, in February-March, the tree presents a most lovable sight, with its bright, large, expanded, golden yellow flowers, which are produced in terminal clusters, so profusely that the tree is literally clothed with a mass of yellow blooms. The diameter of the flowers is 10 to 12.5 cms. As the flowers fade, leaves appear. The flowers are followed by five-lobed capsular fruits, which are as large as a goose-egg and enclose cotton-like fibre and seeds.

* **Colvillea racemosa.** (*Leguminosae*): An ornamental medium sized tree, a native of Madagascar and Mauritius, with a foliage consisting of large twice-pinnate leaves with small linear leaflets resembling those of the "Gul Mohr" (*Poinciana regia*). It bears in September, long, large, compact, drooping racemes, which are nearly 60 cms. in length and are borne principally at the ends of the branches. The tree is very showy while in bloom with its orange-red large flowers, which resemble bunches of Orchids. Propagated from seed.

* **Cordia Sebestena.** (*Boraginaceae*): (Hindi: 'Bhockar'). A dwarf evergreen tree of ideal habit with handsome foliage of oval-formed leaves which are large and rough and measure nearly 15 by 7.5 cms. Terminal clusters of very showy

orange-scarlet flowers are produced in plenty during the rainy season especially and at other times too. The flowers are succeeded by white fruits, which are 1 to 2.5 cms. in size. Very easily propagated by seed, sown while quite fresh. A hardy plant, which will thrive in the open border. A piece of dry wood of this species will perfume the atmosphere in the house if put on a pan of lighted charcoal.

Couroupita guianensis. (*Lecythidaceae*): (Tamil: 'Nagalingam'). Commonly known as the Cannon-ball Tree, on account of the large round fruits. A big erect tree, a native of Tropical America. The tree is deciduous and sheds all its leaves in the course of a single week and is followed by very agreeable pleasing light green large leaves. The flowers are borne in long woody racemes, often measuring 10 to 12.5 cms. in length and springing from the stem. The flowers are sweet scented and are very interesting; they are fleshy, large and possess a curious hood-like structure, made up of united stamens in the centre of the flower, which accounts for the Tamil name. There are two varieties of this species, bearing pink, or maroon flowers respectively. The fruits are globular, dark brown in colour, and are of the size of a small cocoanut. They are very foul smelling when ripen. Propagated from seeds sown fresh, or by suckers, which are produced in large numbers even at great distances from the tree.

Dillenia indica. (*Syn. D. speciosa.*) (*Dilleniaceae*): (Tamil: 'Uva'; Telugu: 'Pedda Kalinga'; Hindi: 'Chalta'). A beautiful, bulky, evergreen tree, with dense handsome foliage of pointed elliptical bright green leaves. It bears in the hot season, very large, pure white flowers, which are 15 to 22.5 cms. in diameter and are succeeded by ball-like acid fruits of the size of a man's fist. They are used in place of tamarind in N. India. The tree is a slow grower, requires plenty of water and a fairly shady situation while young. Propagated from seed. Native of Bengal, South and Central India.

Elaeocarpus ganitrus. (*Elaeocarpaceae*): (Tamil and Canarese: 'Rudrakshi'). An ornamental tree, about 8 metres high, suitable for lawns, avenues or arboretums, producing compact drooping racemes of white flowers from the axils of fallen leaves. The seeds are made into beads and are worn

round the neck by religiously inclined Saivaite Hindus. The flowering period is March–April. Called ‘Bead Tree’.

Erythrina indica. (*Leguminosae*): (Hindi: ‘Pangara’; Canarese: ‘Haluvana’; Tamil: ‘Kalyana Murungai’). The Indian Coral Tree. A coarse tree bearing scarlet-red flowers in erect spikes when the tree is entirely leafless in March–May. Easily propagated by cuttings inserted where the tree is wanted to grow. It serves as good support for climbers and for Grape-vine. The top of the tree is cut back when the shade is too much for them. The white flowered *variety alba* is also handsome when in bloom. *Var-Parcellii* have leaves variegated yellow along mid rib and veins.

* *E. lithosperma* (Dadap): Thornless, evergreen tree, ornamental while in bloom in the rainy season. Useful also for its shade. The loppings make excellent green manure.

* *E. Crista galli*: A dwarf tree with bright scarlet large terminal racemes.

E. Blackii: Another attractive species, a large shrub or small tree, bearing dark scarlet flowers.

* **Gliricidia maculata.** (*Leguminosae*). (*Syn. Lonchocarpus maculatus*): The Madre Tree of South America. A small, very quick growing, good looking tree, with bright green, feathery, arching, leafy branches. In the dry weather, in March–April, it sheds all its leaves when the greater part of the length of the branches are studded with light purplish pink flowers which are clustered into bunches produced from the axils of leaves (leaf-scars). The flowers last for several weeks, making the tree a striking object. Easily raised from seed. Large cuttings, 1 to 1½ metres long, planted *in situ* root soon and grow quickly. The tree is sometimes used for its shade. It is largely grown however for the plentiful supply of its loppings of young stems and leaves used in making compost or as green manure.

* **Guaiacum officinale.** (*Zygophyllaceæ*): Guaiac Tree is small, very slow growing, bearing blue flowers bleaching to lighter colour. A native of West Indies and Tropical America. Economically important as it supplies the resin called ‘Guaiac’ and as its wood is hard and costly.

* **Jacaranda mimosaeifolia.** (*Bignoniaceæ*): A deciduous

elegant tree attaining to a height of about 8 metres. The foliage is pretty, with fine Mimosa-like leathery leaves, broken into small pinnae. Large erect showy panicles of bluish-purple, bell-shaped, flowers are borne in March to May, when the tree has shed all its leaves. The mass of this light blue colour enveloping the tree is a characteristic beautiful sight from a distance. Planted in threes and fives, and grown bushy by not allowing the branches to grow as they please, by topping them once in three years, they are very effective. They fail to bloom in some places like Madras though they make a good show in Trivandrum, Bangalore and the West Coast. Young plants are often grown in pots for the beauty of their foliage. Propagated from seed.

Kigelia Pinnata. (*Bignoniaceæ*): The well known Sausage Tree. It is a spreading, rather coarse looking, moderate-sized shade tree, grown for the peculiar way in which the bunches of dull, purple coloured, tubular flowers dangle from different parts of the branches, at the ends of rope-like stalks, measuring 1 to 1½ metres in length. The flowers are succeeded by enormous sausage-like fruits of a dull brown colour. Each fruit measures 30 to 60 cms. in length and 7.5 to 15 cms. across. The tree thrives anywhere but prefers cool situations such as the margins of ponds. Propagated from seed. Introduced from Australia. Used often for avenue planting.

* **Kleinhovia hospita.** (*Sterculiaceæ*): Named in honour of Mr. Kleinhoff, once director of Botanical Garden, Java. A small evergreen tree of quick growth, 3 to 4 metres high with a spread of 3 to 4 metres with large cordate leaves and small rosy-pink flowers in fine terminal panicles borne practically always but especially attractive in July-August. Deserves to be made more popular. The flowers are succeeded by ornamental pods. Propagated by layers or from seed.

Lagerstroemia. (*Lythraceæ*). *L. Flos reginae* (the Queen's Flower) is rightly styled the "Pride of India", being one of the most showy trees of the Indian forests. There are two varieties. One is a large deciduous tree, with showy mauve-coloured flowers, borne in very great profusion from the ends of branches in large erect sprays. The tree is one

mass of colour when it is in bloom.

* *L. Flos reginae variety rosea* is a much smaller tree, similar to a graft Guava tree, bearing very bright, rose-coloured sprays of flowers. The foliage soon appears with the flowers, so that the brightly coloured flowers standing erect well over the foliage give the tree an extremely fine ornamental appearance. Both the kinds bloom in April-May. Easily raised from seed. The rose coloured variety is a truly fine tree which no garden should be without.

* *L. Thorelli* is another beautiful species, growing 4 to 6 metres high and bearing pretty white and mauve flowers during quite a long season of bloom from June to October.

* **Lysidice rhodostegia.** (*Leguminosae*): A large tree from China, handsome with its masses of light rose-coloured inflorescence produced erect from the ends of its branches. The flowering period is January to March. The calyx is coloured and does not fall off making the tree very showy for a long time.

Magnolia grandiflora. (*Magnoliaceae*): (Hindi: 'Him Champa'). A delicate, very slow growing, small tree, 3 to 4 metres high, never growing more than a shrub at low elevations. The foliage is very pretty, consisting of broad dark green, shining, laurel-like leaves. Large, terminal, very sweet scented, flowers are produced on the older shoots in May and June and occasionally at other times. The tree prefers a semi-shady to an open situation, requires plentiful and regular supply of water and deep rich soil. Propagated by layering or gootying; also from seed, which should be sown fresh and protected from red ants. A rare plant, which needs to be popularised.

M. mutabilis and *M. pumila* are two other very desirable species which are shrubs.

Melia Azedarach. (*Meliaceae*): Persian Lilac. Also called Bead Tree. A small quick growing deciduous tree, 4 to 6 metres high, with graceful foliage of bi- or tripinnate leaves and small heliotrope scented lilac flowers in large panicles. The fruits are small and ovoid in shape. Propagation is from seed. Commonly grown for its flowers, which are offered in worship.

M. japonica is a much dwarfer species suitable for growing the shrubbery.

Memecylon. (*Melastamaceæ*) : There are two species of this genus which are worth growing in the garden for their bright green foliage and scented flowers. They are *M. Heyneanum* and *M. edule* (Syn. *M. tinctorium*). They are woody, large shrubs or small trees, with cheerful glossy foliage of small leaves. In March–April, small lilac-coloured flowers are produced in profusion, clustered in compact little bunches clinging to the stem. Propagated from seed or by layers. Natives of the jungles in India.

Mesua ferrea. (*Guttiferae*) : (Tamil : ‘Nagasuram’ ; Canarese : ‘Nagasampige’). Called the Iron Wood Tree, as the wood is very hard and reddish brown in colour. A moderate-sized ornamental tree of slow growth, with a straight stem and handsome foliage of lanceolate, leathery, shining, drooping leaves. The young blood-red leaves, fading into pink and green, are by themselves ornamental without flowers. The flowers are large, four-petalled and white, with a large yellow eye, formed of crowded numberless stamens. The flowers are highly scented and fill the air with their delightful fragrance to a great distance. The tree is peculiarly suited to humid regions with heavy rainfall. It is easily raised from seed, which should be sown fresh, where the tree is wanted to be grown as the young plants do not bear transplanting well. A deep stony soil and an abundant supply of water are necessary for satisfactory growth. The tree furnishes a useful and lasting timber, which is used for railway sleepers and for heavy machinery.

* **Michelia Champaca.** (*Magnoliaceæ*) : (Tamil : ‘Shambaga’ ; Canarese : ‘Sampige’ ; Hindi : ‘Champa’). A medium-sized indigenous tree, about 8 metres high. A great favourite in Hindu gardens, the exquisitely scented flowers being used for puja and by ladies, who are very fond of them. There are three well known varieties, with creamy light yellow, or whitish, or sovereign red flowers, 5 to 6.5 cms. long, numerous petalled and with short green peduncles. Blooms are borne freely in April–May and again in September–October. The creamy yellow variety is propagated only by grafting on stocks of the ordinary golden orange flowered

kind which produces seeds, in bunches, and which will take 7 to 8 years to flower from seed. The whitish flowered kind is more sweetly scented than the latter but is lacking in substance and hence does not last quite as long. It produces seed but is best grown as a graft on the common stock. The "Simhachalam" golden orange kind is most sweet scented and is the most favoured of the Champacs. Seedlings of this variety bear flowers in about three years, and produce taller trees than grafts which however flower within a shorter period.

Millettia ovalifolia : A fine dwarf tree, flowers in April; is covered with small lilac flowers in drooping clusters.

Millingtonia hortensis. (*Bignoniaceæ*) : (Hindi : 'Akas Nim'). Called the Indian Cork Tree or Tree Jasmine. A tall stately rapid growing tree, brittle and likely to be damaged by high winds. It has densely packed foliage of bright green polished leaves. The flowers are pure white in colour, trumpet shaped, 7.5 to 10 cms. long, very fragrant like Jasmine and profusely borne twice a year, in June and November. Propagated from seed and by sucker.

Mimusops elengi. (*Sapotaceæ*) : (Tamil : 'Maghadam'; Telugu : 'Poghada'; Hindi : 'Mulsari'; Canarese : 'Pagade'). A middle-sized, handsome, evergreen tree, with crowded, dark green, polished leaves bearing twice a year, small, white, very fragrant, pale white, star-shaped, double flowers, which are hidden in the foliage. The flowers are greatly in demand in the market, Hindu women being very fond of them. A scent is prepared from the flowers. A great favourite in large Indian gardens. The female tree bears orange-red berries which are edible. Propagated from seed. A variegated form of this tree is small and would be beautifully placed in the centre of a lawn.

Nauclea cadamba. (*Rubiaceæ*) : A large deciduous tree with pretty yellow flowers, borne in August–November.

Ochrocarpus longifolius. (*Guttiferæ*) : (Canarese : 'Suragi'; Tamil : 'Punga'). A small, very slow-growing tree, about 6 metres high, with dense foliage of laurel-like large leaves, which are 20 to 25 cms. long and 6 cms. broad, leathery, pendulous and shining, affording a cool shade. The stem is straight and bears branches, which are opposite and

disposed at nearly right angles to the stem. The flowers are white, four-petalled, very sweet scented and are borne in axillary clusters, on the trunk and the limbs. The flowers are fragrant even when dry. Raised from seed. The tree is a native of Kanara and other moist districts. It needs protection from hot winds.

Oncoba spinosa. (*Bixaceæ*): A small bushy tree with light green small ovate leaves. It bears during April–May from the underside of the young branches, showy, solitary, scented, white flowers with innumerable yellow stamens. The tree is somewhat thorny, and is, hence, useful as a barrier on the boundary line.

Parkia. (*Leguminosæ*): Canarese: “Sivalinga mara”. *P. Biglandulasa* is a large upright stately showy quick growing evergreen tree, named after the famous African traveller, Mungo Park. The foliage is very pretty, being feathery and consisting of bipinnate leaves, which are 30 cms. or more long; there are 45 to 50 pinna to a leaf; each pinnae is 7.5 to 10 cms. long, and each pinna has about 150 minute pumules. The petiole or leafstalk has two small glands, and hence the specific name. The inflorescence consists of axillary pendant globular flower heads, about $2\frac{1}{2}$ cms. in diameter, which are suspended by long peduncles. The individual flowers are very small and insignificant. The heads, are at first, of a brown and velvety colour and they become white, as the flowers open. The tree is very interesting with its brown and white balls of flower heads dangling down the branches, supported by the long peduncles. It thrives in any garden soil with slight attention while young. A good avenue and shade tree. Propagated from seed.

P. Roxburghii is an equally ornamental magnificent tree; very valuable as a shade tree.

* **Peltophorum ferrugineum.** (*Leguminosæ*): The yellow Gul Mohr. A large quick growing tree with a symmetrical spreading top and fine graceful feathery foliage consisting of pinnate leaves with small leaflets resembling those of the tamarrind tree. The tree gives a good shade. Flowers are borne in April–May, in large, erect, pyramid-shaped, panicles of a pale yellow colour. The flowering period, is however,

irregular, some trees blossoming long after their neighbours have finished flowering. Clusters of dark brown pods succeed the bunches of flowers and adorn the tree for quite a long period. Very valuable for avenues or for shade. Easily raised from seed.

Plumeria. (*Apocynaceæ*): Also spelled Plumiera. This genus provides some attractive species. In all, stems are stout and milky. Leaves are large and deciduous in most species. Flowers are fragrant, large, waxy and produced in great profusion, clustered in terminal cymes. All are easily propagated from cuttings. Introduced from Mexico.

P. acutifolia: "Khair champa" is known as the Temple tree or the Pagoda tree and it is the commonest species, being planted near Mahomedan burial grounds and Buddhist temples. It is a low-spreading gouty-looking tree, with stout branches and branchlets, bearing large oblong leaves, which are nearly 30 cms. long and 7.5 cms. wide. The tree is leafless during a great part of the year but is seldom without blossom. The flowers are white, flushed with yellow, have an yellow centre, are about 7.5 cms. wide, very fragrant, and clustered in terminal cymes. Rather an uncouth tree for a small garden.

* *P. Lambertiana*: A small tree with dark evergreen shining foliage of oblong-lanceolate leaves. The tree is in blossom throughout the year, bearing pure white flowers, which are very attractive and highly scented and are arranged in erect clusters at the ends of branches. A very handsome tree, which no garden should be without. Once in 4-5 years, the lanky branches may be cut back for vigorous fresh shoots.

P. hybrida Rene: This attains a height of about 4 metres spreads very much at the top, eventually becoming umbrella-shaped. The leaves are large, broad and light green. The tree is very pretty in April-May, with its fresh foliage and large terminal bunches of flowers, which are very freely produced. Each bunch measures as much as $\frac{1}{2}$ metre across, and is composed of numerous flowers, which are 7.5 cms. in diameter. The flower is light pink and white in colour, with a shading of fine rose colour towards the edges of the petals, and with a golden-orange centre, shading to crimson; on the underside of the petals, the colour is light pink, with a beautiful band of

rose coloured edging, towards the margin. The flowers are very pleasantly scented.

P. rubra (Frangipani Plant) is a much smaller tree than the two preceding species. It produces bright crimson flowers, with a golden yellow centre, in April–May, and remains in bloom for several months. A very desirable plant.

* *P. alba* is a large shrub, very handsome with its bright foliage of dark green, large, polished leaves and pure white large, well shaped, highly scented flowers with rounded expanding petals.

P. lutea bears large flowers, 7.5 to 10 cms. in diameter and yellow with yellow throat.

* **Poinciana regia.** (*Leguminosæ*): The well known "Gul Mohr Tree". Also called the Peacock Flower, and the Flamboyant. A tree with a large spreading top and fine feathery deciduous foliage of pinnate leaves with small leaflets. It is quick growing, easily raised from seed, very handsome and striking when in bloom, being enveloped in a mass of crimson-scarlet or orange-scarlet large flowers, arranged in large erect panicles, between April and May. The tree is very valuable in gardens for shade and near the confines for effect. It makes a very fashionable avenue. The pods are sword-like, 45 to 60 cms. long, are at first green and then turn black and are suspended from the branches after the flowers are over. A native of Madagascar.

Pterocarpus indicus. (*Leguminosæ*): (Hindi: 'padouk'). The Burmese Padouk. Also called the Gul Mohr Tree of Singapore. A large tree with spreading rounded top and drooping branchlets. Bears golden, sweet scented flowers several times a year, making it worth growing in a large garden. A valuable timber tree.

* **Pterospermum acerifolium.** (*Sterculiaceæ*): (Hindi: 'Kanak-champa'). An ever-green, small, erect growing tree with magnificent striking foliage, consisting of large (nearly 25 cms. long by 17.5 cms. broad), tough, thick, leathery, oblong and heart-shaped leaves, which are dark green above and silvery white underside. The tender young stem and young leaves are covered with a coating of rough hair, which drop off with age. Large white flowers are produced freely in

April–May. The flower mainly consists of large fleshy thick sepals which are five in number, hairy, rough, and of a dull sepia colour on the outside and pale yellow on the underside. The corolla is pure white in colour and is small compared with the sepals. The flower buds are rough to the touch and are of a dull sepia colour, and are borne in bunches of three flowers from the axils of leaves in the terminal portions of the branches. Propagated from seed. A tree which should find a place in every garden for the delicate fragrance of its flowers and the large handsome foliage.

Saraca: (*Leguminosæ*): A group of ornamental small and medium-sized trees, allied to *Brownea*. The following species deserve commendation:—

Saraca indica. (Tamil, Canarese and Hindi: 'Asoka'). An indigenous evergreen slow-growing small tree, sacred to the Hindus and Buddhists, with the young leaves clustered and drooping as in *Brownea* and *Amherstia*. On the stems and branches are borne the flowers, which are slightly scented, in dense round erect panicles, 7.5 to 15 cms. in diameter, changing in colour from yellowish orange to orange-scarlet. The rush of bloom is from February to May but the tree bears flowers intermittently throughout the year. It prefers a semi-shady and sheltered situation but is nevertheless very hardy and easy of culture. Propagated from seed.

* *S. declinata* is a dwarf very slow-growing tree, prettier than *S. indica*, bearing larger clusters of flowers. This Sumatran species comes into bloom sooner than the indigenous species, when it is only $\frac{3}{4}$ to 1 metre high. Propagated from seed.

* *S. califlora*: A distinct *Saraca*. A medium-sized deciduous tree of good habit of growth with pretty green foliage. Flowers are produced in loose clusters in great profusion in summer in February–March. Pretty as a single specimen on the lawn.

* ***Solanum macranthum*:** (*Solanaceæ*): Called the "Potato Tree". Grows quick to a height of 4 to 5 metres, and has an evergreen foliage and a graceful spreading habit of growth. The branches are herbaceous and are here and there armed with spines. The leaves are large, 20 to 30 cms. long, 12 to

15 cms. broad, and are nicely lobed; they are rough, covered with woolly hair, both on the upper and on the under side, and they have three or four spines on the midrib on the underside. The tree is perpetually in blossom; the flowers are arranged in clusters showing themselves well above the foliage; they are about 2.5 cms. across and resemble the flowers of the Potato. The corolla is five-lobed and is of a bluish mauve colour, which bleaches to almost white. The fruits are large, as big as a billiard ball. Propagated from cuttings are by seed. A very handsome tree suited for small gardens; can be placed with large shrubs in the shrubbery. Thrives best in sheltered partially shaded situations.

* **Spathodia campanulata:** (*Bignoniaceæ*): (Canarese: "Neerukayi mara"). Called the Flame or the Tulip Tree, or the Fountain Tree. A soft-wooded, tall, erect, deciduous tree, grown both for its shade and ornamental appearance. A striking tree for avenues, probably too big for private gardens. The leaves are glossy and bright green; they fall off for a few weeks and new ones appear with the blooms in June-July. Large cymes of bright orange-scarlet flowers are produced at the tips of the branches throughout the wet season rendering the tree charming and conspicuous from a great distance. The young flower buds are soft and velvety and olive-coloured; they are hollow, contain a clear liquid, and are loved by children who use them as water-squirts. A native of Tropical Africa.

S. nilotica is of smaller growth than the above and the flowers are brighter and orange-red in colour. Begins to bloom when only 3-4 years old.

Sterculia: (*Sterculiaceæ*): A large genus of ornamental large trees. The following are a few noteworthy species:—

* *S. acerifolia*, known as the "Flame Tree" is a native of South Australia. It is a moderate-sized but tall erect-growing deciduous stout-stemmed tree with foliage consisting of large glossy leaves. The tree bears in May in great profusion, characteristic brilliant scarlet flowers in long pendulous clusters, when the tree has completely shed its leaves. The whole tree is a mass of colour and hence, the common name. Propagated from seeds.

S. colorata: Native of Ceylon. Moderate-sized tree growing to a height of about 10 metres. Flowers are orange-scarlet and borne as in the preceding species. Striking, when it is leafless.

S. diversifolia: From Australia. Called the Bottle Tree on account of the remarkable shape and size of the trunk, which looks like a big bottle. The leaves are various shaped and hence the name *diversifolia*. Flowers are greenish-white and reddish within.

S. lanceolata is another very attractive species, smaller than the above.

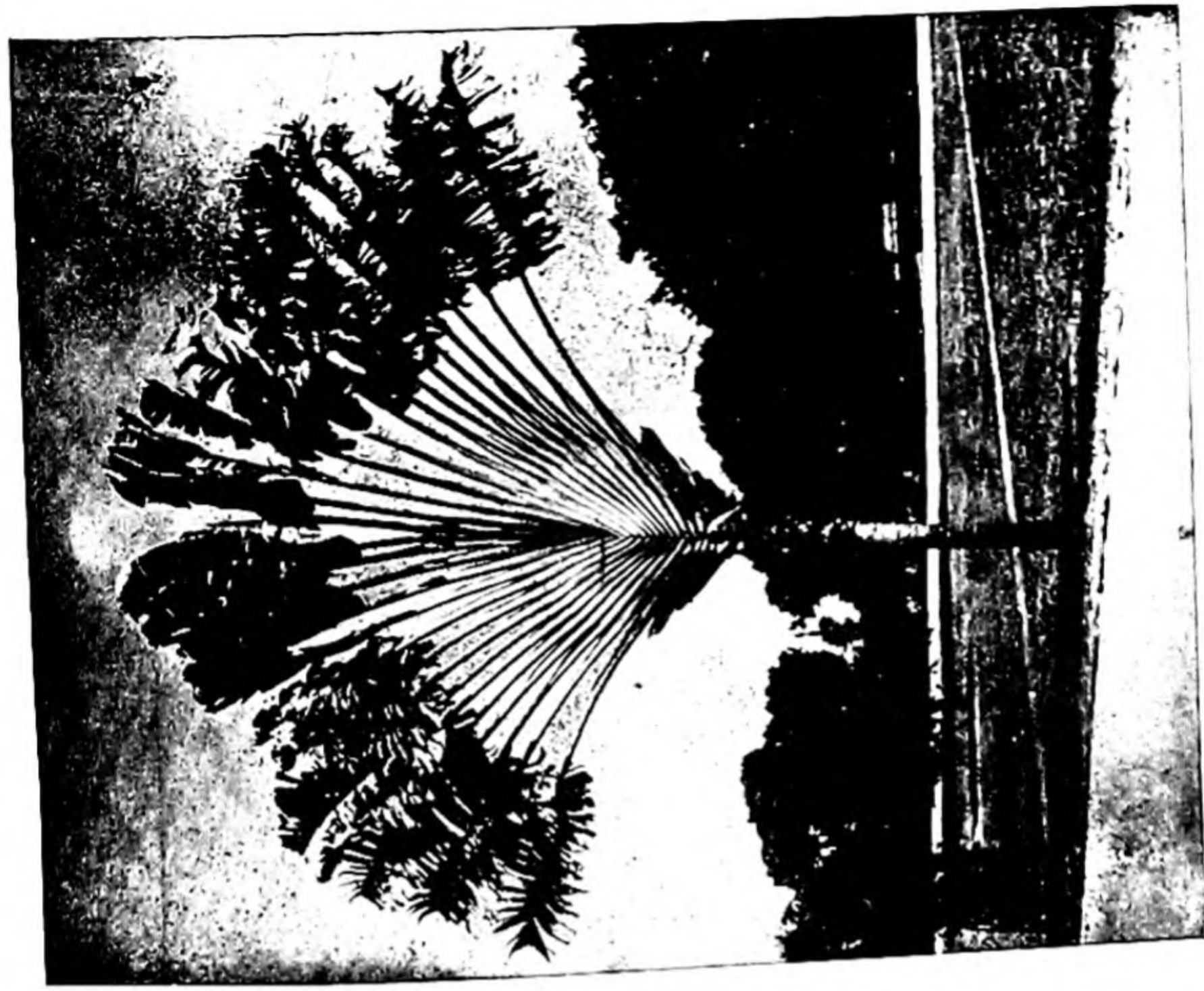
Stereospermum. (*Bignoniaceæ*): *S. suavelens* (Tamil and Canarese: 'Padiri') is a large, spreading, popular tree of South India, grown in temples. It is deciduous for a short time in summer, when it bears terminal panicles of dull purplish pink pleasingly scented, bell-shaped flowers, which are used for puja purposes. Too huge a tree for gardens.

S. xylocarpum is white flowering tree.

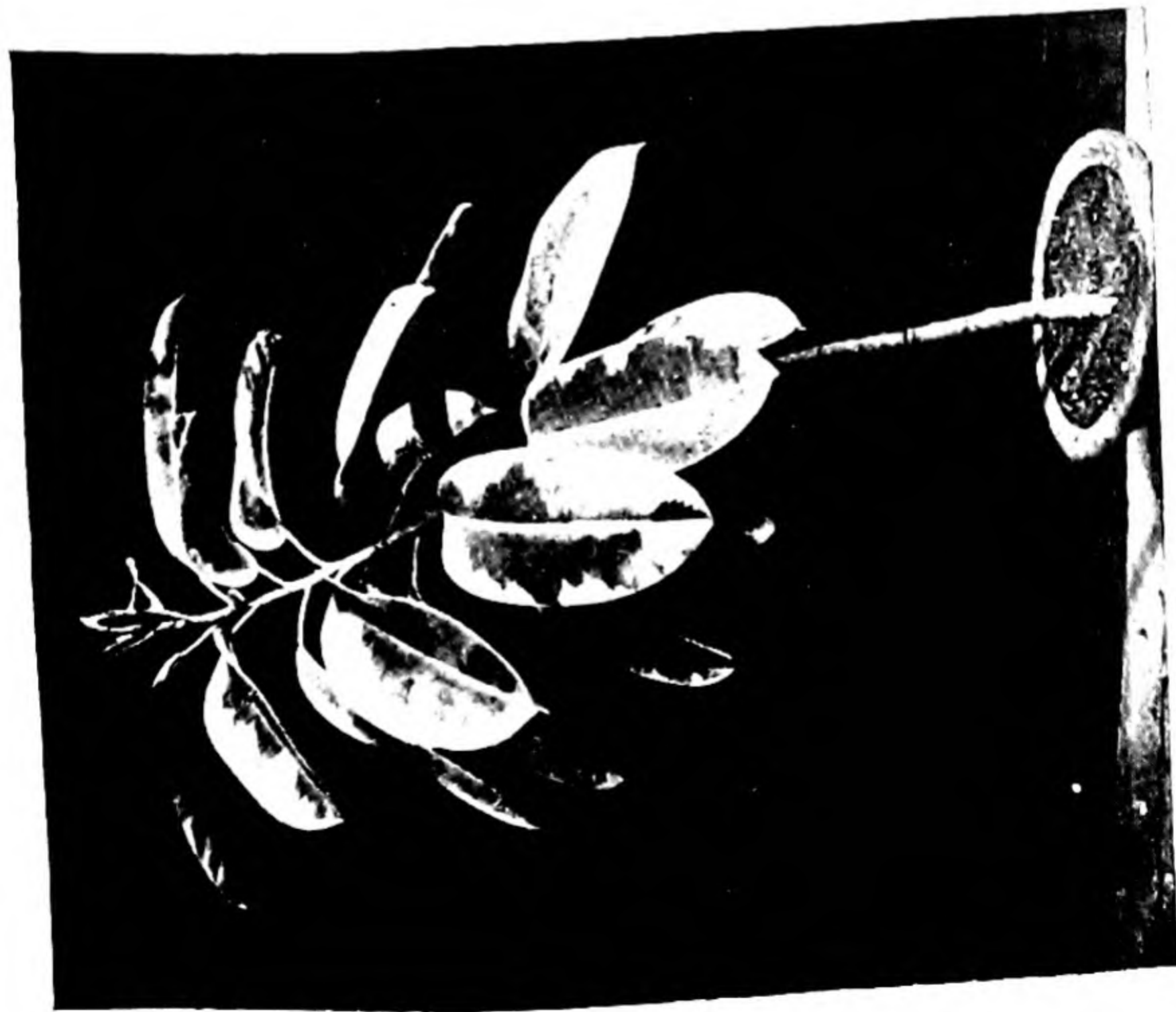
S. chelenoides: The flowers are yellowish, fragrant.

Tabebuia. (*Bignoniaceæ*). *T. spectabilis*: A small tree which produces a mass of bright yellow flowers in large erect bunches when the tree has shed its leaves in March–April. Strikingly beautiful when in bloom which is only for a short period of 10–15 days. Foliage is very pretty too. *T. rosea* is also an attractive species. Flowers are lovely pink mauve in colour. *T. argentea* is lovely slow growing tree with very bright yellow flowers. *T. guayacan* is the prettiest of all bearing beautiful flowers of light apricot-magenta, a very rare shade of colour.

Thespesia populnea. (*Malvaceæ*): (Canarese: 'Huvarsi'; Tamil: 'Pursa'). The Portia tree is ever-green and rapid growing, is usually planted by temples and in avenues. Leaves are cordate-acuminate, forming a dense head of foliage and hence, the tree is sometimes called the Umbrella Tree. It is also called the Tulip Tree by some people, as its flowers resemble tulips. The flowers are hollyhock-like, yellow in colour with reddish blotches at the base passing to rosy-violet white withering. Flowers throughout the year. Propagated from seed and by large cuttings. Economically a valuable tree.



RAVENALIA MADAGASCARIENSIS



FICUS ELASTICA VARIEGATUM



CASSIA RENIGERA

* **Wrightia tinctoria.** (*Apocynaceae*): (Canarese: 'Bep-pale'). Called the Ivory Wood tree, because its wood is ivory white and used in the manufacture of toys. It is a small handsome tree with slender cord-like branches bearing in very great profusion in March-May, fragrant jasmine-like white star-shaped flowers, 1 to 2 cms. in diameter, clustered in terminal and sub-axillary cymes. A native of India.

* *W. coccinea* is very handsome in the hot months with deep-red flowers.

W. antidysenterica (Syn. *Holarrhena*): (Sanskrit: *Vrak-shaka*). The Easter Tree. Bears in the hot season corymbs of cream sweet scented flowers. Its bitter astringent bark is a chief anti-dysenteric remedy.

All the above species are propagated from seed or by cuttings put down in the rainy season.

(B) SELECT ORNAMENTAL FOLIAGE TREES

Alstonia scholaris: (*Apocynaceae*). The Ditebark or Devil's Tree. An ornamental evergreen tree, suitable for growing on a lawn as a single specimen, with handsome foliage consisting of leaves with the upper surface glossy and the under surface whitish and borne five to seven in whorls. The flowers are pale green and scented. Wooden slates used by scholars were made out of its wood and hence its specific name.

Araucaria: (*Coniferae*). Genus of very ornamental Coniferous evergreen trees from South America and Australia, eminently suited for planting on lawns, where they show themselves very effectively. All are immense, tall trees but are very slow growing, hence are well suited for pot or tub culture, for decoration of the verandah, window and the drawing room. The plants can be continued in tubs or pots for several years by restricting their root space and repotting them every year. The trees are remarkable for their symmetrical and orderly growth. They grow with little care in any good garden soil but they prefer a deep, loamy, well drained soil, which is regularly watered. Propagated by seeds. But, they can be raised by gootying vertical shoots; horizontal shoots do not make good straight specimens of plants.

The following species, all reaching a height of 30 to 60 metres ultimately are noteworthy :—

* *A. excelsa*, called the Norfolk Island Pine, is a very handsome species. A very tall tree, conical in shape, with short, slender, horizontal branches starting from the trunk with a certain regularity, resembling a gigantic candlebra; the branches have a graceful feathery appearance. Thrives very well on the plains.

A. Cookii is similar to the above but thrives in high altitudes. Called the New Caledonian Pine. Forms an ideal Christmas Tree.

A. Cunnighamii does well in the plains, though it does better between 600 to 1000 metres above sea level. Called the Moreton Bay Pine. A comparatively rapid grower with more spreading and horizontal branches and less formal than the above two species.

A. Bidwillii: Called the Monkey Puzzle Tree as it bears branches down to the ground and the leaves are stiff, and closely set ending in sharp points, puzzling a monkey to climb up.

* *Artocarpus incisa*. (*Urticaceae*): (Tamil: 'Seemai-pala'). The Bread Fruit Tree. A native of South Sea Islands and naturalised in parts of Ceylon and West Coast of India. A very handsome quick-growing evergreen tree, which attains a good height and spread, and has very large, polished, dark green, palmately-cut leaves. The tree is strikingly ornamental and provides fairly good shade. The fruit is oval in form and is of the size of a small melon and has the general appearance of the Jack fruit, to which it is very nearly allied. The fruit of some varieties are without seeds and the inside resembles the soft inside of a loaf of bread and is used as vegetable. The bread of the fruit sliced and fried makes excellent chips. The tree requires a rich loamy soil and plenty of water. It thrives best in coastal regions and in districts where there is a humid atmosphere and equable temperature. Propagated by suckers taken from selected trees and kept in sand till they strike root, and by root cuttings.

Artocarpus nobilis and *Artocarpus integrifolia*: See Chapter XXXI.

Artocarpus Cannoni is a small tree which is often grown for its pretty foliage consisting of large oblong leaves which are of a lovely purplish bronze colour when new. The tree may be safely cut back when the branches get straggly.

Casuarina equisetifolia. (*Casurinaceae*): (Tamil: 'Chavukku'; Canarese: 'Sarve'). A lofty tree of rapid growth with fine slender branchlets, 15 to 20 cms. long and borne in place of leaves. It is quite ornamental while young. This is the well known fuel tree which is cut down when 8-10 years old. Propagated from seeds.

Cinnamomum camphora. (*Lauraceae*): A small evergreen tree, which is bushy and has foliage down to the ground. A native of Famosa. The tree has a conical shape, especially while young. The leaves are greyish green, lanceolate and finely scented. Economically, the tree is valuable, as by distillation of its leaves and wood, the camphor of commerce is obtained. Bears white panicles of flowers, which are not particularly showy. Propagated by seed.

Cupressus. (*Coniferae*): Also called Cypress. Genus of evergreen trees and shrubs, which are grown for the beauty and grace of their fine form and foliage. They thrive at altitudes between 800 to 2,000 metres, in a deep sandy loamy soil. But in the plains or at low elevations, hardier species as *C. sempervirens* can be grown with success in pots in partial shade, well protected from hot winds. Even at medium elevations, as at Bangalore, the plants unless shaded in summer from severe sun, die, especially when young. Some of the Cypress stand trimming very well and are hence very useful for topiary work. At higher elevations, hardier kinds as *C. sempervirens* are used for ornamental hedging. Propagated from seeds which take several weeks to germinate, by gootie, or by layers and sometimes by cuttings of the ends of branches planted in sand in August-October. The following species are recommended:—

* *C. sempervirens* ('Saru'): Called 'Meditaranean Cypress'. Easily grows 7 to 10 metres reaching 20 to 30 metres ultimately: upright and conical in form. This is the common and hardy variety which is grown in mosques and which was used in Moghul gardens. Suited for low elevations.

C. torulosa (Syn. *Nepalensis*): Himalayan Cypress, also called Bhutan Cypress, is erect and tall growing.

C. pyramidalis is a variety of *sempervirens*. A tall erect tree with whippy adpressed branches.

* *C. macrocarpa* (The Monterey Cypress) = *C. Lambertiana* is densely packed with ash green fine slender leaves; stands trimming very well and is frequently seen as a hedge in formal gardens.

* *C. funebris* is called the Weeping or Mourning Cypress. It easily grows to about 6 metres and reaches an ultimate height of about 15 metres; has a drooping habit like that of the Weeping Willow. Grown in cemeteries.

C. horizontalis, *C. Lawsoniana*, and *C. arizonica* are other species.

Erythrina Parcelli. (*Leguminosae*): A small quick growing soft-wooded tree. The foliage is ornamental, the leaves being variegated by creamy yellow bands and markings along the veins. Flowers are orange coloured. Propagated by cuttings,

Eucalyptus. (*Myrtaceae*): A large genus of very tall gigantic trees, natives of Australia, popularly called the Blue Gums. Eucalyptus oil is prepared from the leaves. The breeze from the trees is said to possess anti-malarial properties. Almost all the species thrive at medium to high elevations. But, *E. citriodora*, *E. rostrata* and *E. alba* grow well in the plains. *E. citriodora* is specially recommended as it is particularly suited for small gardens too. It is an upright, handsome, slender, evergreen tree, with smooth white bark and dark green leaves, with a lemon-scented odour. The tree can be cut down to the ground level and the new shoots allowed to grow making a bushy growth.

E. globulus is the typical Blue Gum, which thrives above 1350 metres.

* *E. filicifolia* is a showy species, bearing crimson flowers in great profusion. A small tree suitable only for hill stations.

E. marginata and *E. crebra* are two other handsome species for hill stations. All the species are raised from seed.

* **Filicium decipiens.** Syn. *Pteridophyllum decipiens* (*Burseraceae*): "Fern leaved Tree". Grows 5 to 10 metres high

with a spread of about 10 metres. It is a very ornamental tree of slow growth, with bright green polished, compound leaves, which resemble fern fronds and are used for decoration indoors. In the young state, the plant is equally ornamental and hence is grown in pots for decoration purposes. The tree is very hardy and grows in any good soil; it is easily propagated from seeds, which should be sown fresh.

Grevillea robusta. (*Proteaceae*): Named in honour of C. F. Greville, a patron of botany. Popularly known as the Silver-oak, is a tall Australian tree, 10 to 15 metres high, handsome when young, with its evergreen foliage, consisting of deeply incised twice pinnate leaves, which are fern-like and are dark green above and silvery-grey on the underside. The mature trees produce abundantly, orange coloured flowers, in racemes. An altitude of 600 to 1,500 metres and deep open soil and frequent watering while young are necessary for successful cultivation. Easily raised from seed. Seedling plants, which are about six months old are nearly $\frac{1}{2}$ metre in height; they are useful as pot plants for decoration purposes. A good tree for planting as wind-break. It is handsome while in bloom in April-May. Pruning is necessary after 6 or 7 years to keep it in shape. There are other more attractive species, which however do not thrive at lower elevations.

Heritiera littoralis. (*Sterculiaceae*): Called the Looking Glass Tree. Medium-sized, evergreen and distinctly ornamental. Leaves are large, close packed, oval-oblong and rounded at the base, bright green above and silvery beneath, having the appearance of the back of a looking glass. Fruits are brown and are of the size of walnuts. They are borne in clusters and are interesting. Propagated by seed.

Juniperus. (*Conifereae*): Conifers suited for medium to high elevations. The Bermuda Cedar, *Juniperus Bermudiana* is a slow growing medium-sized erect tree with bluish green foliage. Thrives best at high elevations. *J. chinensis* is a compact growing dwarf tree or shrub with bluish green foliage, which may be tried in the plains and medium elevations. The dwarf form or shrub, *J. procumbens* = *J. horizontalis* may be used in rock gardens.

Muntingia calabura. (*Tiliaceae*): Singapore Cherry. A small or medium-sized tree, growing to a height of 5 to 7 metres and spreading nicely making it useful for shade. It is of good growth and regular outline and is a great favourite with the Chinese. It bears small white flowers and small red berries which are useful for making jam and tarts.

Parmentiera cerifera. (*Bignoniaceae*): The Candle Tree. A quaint tree of small growth, a native of Panama with small light green, twice trifoliate leaves. Interesting fleshy candle-like cylindrical yellow fruits are borne in profusion from the stem and along the branches in the drier months.

* **Pinus longifolia.** (*Coniferae*): A lofty Pine, a native of the Himalayas, thriving from 500 to 2000 metres above sea level. It is useful in large gardens as it is very effective when placed on lawns. The tree is very slow growing and it is remarkable for its needle-like, long, pendulous leaves, which are nearly 35 cms. in length. Good specimens of this tree can be seen in almost all public gardens of importance in India.

Pisonia alba. (*Nyctaginae*): (Canarese: 'Sule soppu'; Telugu: 'Lanchamundaku'; Tamil: 'Lechai kottai' or 'Chandu'). Popularly known as the Lettuce Tree or the Lady Love. A small evergreen tree, with ornamental, dense foliage of pale green, leaves, which are large and have a refreshing appearance. The new leaves are alleged to have medicinal properties, being cooked and taken internally as a vegetable for rheumatic pains, and they are a good food for cattle. Propagated very easily by cuttings.

* **Podocarpus chinensis.** (*Coniferae*): A dwarf evergreen tree of very very slow growth, reaching a height of 8 to 12 metres in many years, with lance-shaped leaves. Very ornamental in appearance, is particularly suited for planting on lawns.

* **Polyalthia longifolia.** (*Anonaceae*): (Tamil: 'Maraillupai'; Hindi: 'Asok'). Called the Mast Tree. It is an elegant, erect-growing tree with shining, lance-shaped, bright green, polished leaves, and wavy branches. The leaves are used for decoration with flowers. The tree is specially suited for dry regions and is useful for avenues. If planted close to each other, the trees form a high screen. As the plants do

not transplant well, seeds are best sown where the trees are wanted to grow in ready made pits filled up with suitable soil. After one or two years, they need very little attention. They are drought resistant and have no partiality for any particular kind of soil. In the young stage, they are capable of being trimmed to shape. Planted alongside roads and trained as standards with conical tops. The seeds should be sown quite fresh when they ripen, about the end of July. The weeping variety of the above, *var. pendula*, is more ornamental.

* **Putranjiva Roxburghii.** (*Euphorbiaceae*): (Hindi: 'Jalpitri'). A medium-sized evergreen tree with a very neat spreading habit. It is clothed with dense foliage of dark green leaves with the general effect of a weeping tree. It is more beautiful than *Polyalthia* and is good for any garden.

Ravenala Madagascariensis. (*Scitamineae*): Popularly called the Traveller's Tree of Madagascar because the tree collects water in the sheathing bases of its leaves and this water is alleged to be made use of by travellers in arid regions. The tree is remarkable in appearance, being tall and evergreen, with its immense distichous leaves which very much resemble those of the Banana and which are arranged in one plane giving the appearance of a gigantic fan, surmounting a thick succulent stem. There are as many as 20 to 24 such leaves on a tree and the stalk of each leaf is about $1\frac{1}{2}$ metres in length; the lower ends of the leaf-stalks are firm and sheath the stem firmly, forming receptacles holding the water collected during the rains. The seeds are blue and very hard. The tree is propagated from seed or by suckers, which are produced under mature trees. To be effective, the trees should be placed in groups of fours and fives, planted 2 to 3 metres apart.

* **Schinus molle.** (*Anacardiaceae*): Called the Californian Pepper Tree. A medium-sized, very ornamental, evergreen tree which attains a height of about 6 metres. The branches and branchlets have a pendulous habit and the foliage is graceful and drooping willow-like; it consists of fine pinnate leaves which are about 22.5 cms. long. The tree produces panicles of inconspicuous whitish flowers, which are followed by red berries, resembling pepper corns. The leaves and the berries are resinous and have a strong smell of pepper. The tree is

excellently suited for single planting on a lawn. Propagated by seed and by layering.

Schleichera trijuga. (*Sapindaceae*): Called the Ceylon Oak, as the foliage resembles that of the English Oak. A large tree but of very slow growth. The new leaves are deep carmine-red. The tree is useful for lac culture.

Thuja. (*Coniferae*): Thujas or Thuyas, are a genus of very ornamental, very slow growing, evergreen, woody shrubs or small trees, which are grown for their formal habit of growth and their neat fern-like, bright green foliage. They are useful as pot plants; they may be continued in pots for several years by repotting them or top-dressing the soil once a year. Most of the kinds stand trimming very well and several species do not require any trimming at all as they naturally grow to a lovely conical or pyramidal form. The garden forms of Thuja are very bushy and low, the branches being many, horizontal and much ramified. The branchlets are flat, green and frond-like, the leaves being scale-like. Thujas are excellently suited for planting on lawns. *T. orientalis* is the commonest species. It is well known as Arbor Vitae. It is a small bushy tree of conical shape with laterally flattened branches. It is suitable for clipped hedge. A native of China and Japan. Propagated from seed or cuttings of erect branches; cuttings taken from lateral branches result in plants which have a tendency to grow in the horizontal direction.

T. gigantea is a large growing species.

* *T. orientalis var. compacta* is the best, being the most ornamental, a dwarf shrub with thickset foliage and forming a neat globular or slightly conical specimen.

Terminalia catappa. (*Combretaceae*): (Canarese and Tamil: 'Badami'; Hindi: 'Dese Badam'). The Indian Almond Tree. Fairly large, quick growing tree, about 10 metres high, or handsome stately growth with branches, spreading horizontally and coming from the main stem or axis in whorls. The tree is deciduous and the leaves are large, bright, polished and deep green. It affords cool dense shade. The fruits are edible, a nut similar to almond being enclosed in them, thus accounting for the common name. Propagated from seed.

Trevesia palmata. (*Araliaceae*): A small tree, sparsely branched, growing to about 6 metres. Very large, spreading Palmate leaves are crowded at the ends of the branches. The leaves are nearly 45 cms. across and have leafstalks nearly 45 cms. long. Flowers, 2.5 cms. across and yellowish-white in colour, are produced in showy long peduncled paniced umbels. Flowers are succeeded by big large round showy clusters of berries. Suited for shade gardens at medium elevations. Likes a moist situation. A native of Himalayas. Propagated from seed.

Wigandia caracasana. (*Hydrophyllaceae*): A tall shrub or a small ornamental tree, about 4 metres high, with handsome pleasing foliage, consisting of large, wrinkled, more or less downy leaves, which are nearly 45 by 25 cms. Lilac blue coloured flowers are produced in showy terminal cymes. Propagated from seeds, which are very small. A native of Mexico.

(C) SHADE TREES

Lists A and B contain some trees, which are also useful for shade. But, this list includes large trees, which are particularly grown for their shade, and are suitable only for large gardens.

Acrocarpus fraxinifolius. (*Leguminosae*): (Tamil: 'Howlige maram'; Canarese: 'Avalige'). Pink Cedar. Shingle Tree. An upright, tall, clean stemmed, medium, quick growing, deciduous tree with long but rather slender branchlets and handsome bipinnate leaves. The young foliage is red tinted and brightens the tree at most seasons of the year. Often used as shade for coffee. Wood is used for making furniture, tea-chests, and shingles. Propagated from seeds, which are brown, flat and small.

Adenanthera pavonina. (*Leguminosae*): (Hindi: 'Rakta chandan'; Tamil: 'Kundumani'). Called the Bead Tree; very common in Southern India, a native of Malaya. It is a good quick growing evergreen shade tree, attaining a large spread and good height. The seeds are bright glossy and red, looking like beads, and used by goldsmiths for weighing small quantities of gold. Propagated from seed. *A. bicolor* is less

common and bears smaller but more ornamental seeds, which are half black and half red.

Amoora rohituka. (*Meliaceae*): An evergreen tall spreading tree, belonging to the Neem family. The oil from its seeds is used for lighting. Native of Ceylon and India.

Albizzia. (*Leguminosae*): A genus of large quick growing shade trees with thin feathery foliage, which are ornamental and bear scented flowers. *A. Lebbek*: (Tamil: Vahai). Well-known as the Siris Tree, after its Sanskrit name. Native of Tropical Asia and Africa. It is a large tree with evergreen foliage, often planted for shade. Well suited for roadside purposes. Furnishes excellent timber for furniture.

A. moluccana is also handsome and quick growing and is admirably suited for shade purposes. It reaches a height of 30 metres. Its graceful grey stems and the flat spread of its branches make it a striking tree.

Other good species are *A. Richardiana*, *A. odoratissima* and *A. procera*.

Anda Gomesii. (*Euphorbiaceae*): A tall, spreading, evergreen tree. The flowers are white.

Azadirachta indica. (*Meliaceae*): (Canarese: 'Bevu'; Tamil: 'Vembu'). The Margosa or the Neem Tree. A very useful, medium-sized, evergreen tree, with dense foliage of shining light green, deeply serrated leaves. The flowers are pale white and pungently scented and are borne in loose clusters, which are followed by yellow drupes. The tree is very common in Indian gardens, its leaves and flowers being very greatly in demand. Bunches of leaves are tied in front of the house to indicate that small-pox is prevalent or that some death or birth has taken place in the house. The leaves, bark and root have astringent and tonic properties and are used largely in Hindu pharmacopoeia. The neem oil is used for killing borers attacking plants and in medicine and for making soaps. The tree is very hardy, provides excellent shade, and the breeze from it is considered good for health.

* **Bassia longifolia.** (*Sapotaceae*): (Canarese: 'Hippe'; Tamil: 'Illuppai'). A large deciduous tree.

Bischofia javanica. (*Euphorbiaceae*): An evergreen, tall, spreading tree.

Caesalpinia coriaria. (*Leguminosae*): Known as Divi Divi, native of C. America and West Indies. Spreading moderate sized tree looking like a huge umbrella with finely pinnate leaves and greenish-white, sweet scented flowers in small bunches. Especially suited for places with light rainfall. The pods afford a valuable tanning material. It is difficult to grow anything under its shade.

Cassia siamea. (*Leguminosae*): A medium-sized very hardy tree, bearing yellow terminal bunches of flowers almost throughout the year. It is very easy of propagation from seed and is very quick growing, which is the merit which induces several persons to grow it.

Castanospermum australe: See page 243.

Dalbergia Sissoo. (*Leguminosae*). The Sissoo (Shisham) is a common jungle tree, useful for planting by roadside, as it grows rapidly and transplants well. The flowers emit a delicate fragrance in the evening. The species *D. lanceolata* is superior to the latter and is pretty when covered with its pale lavender coloured flowers.

Diospyros embryopteris. (*Ebenaceae*): (Tamil: 'Panich-chai'). Moderate-sized, evergreen slow growing tree with spreading branches and brilliant red new foliage. Native of India, Ceylon and Malaya.

* **Ficus Benjamina.** (*Urticaceae*): (Tamil: 'Alamaram'; Telugu: 'Mari chettu'). Known as the Java Fig Tree. It is one of the finest trees in cultivation, with bright, glossy, light green small round leaves, borne very thickly in graceful drooping arching branches. It is slow growing but attains great height and very wide spread with excellent form. It is one of the finest evergreen trees for large avenues, where plenty of cool shade is desired.

Ficus bengalensis: Banyan Tree. It is a large smooth barked tree, growing to a height of about 20 metres and spreading over a very large area. The aerial roots produced from the spreading branches hang down, grow gradually till they reach the ground, when they soon strike root into the soil and in course of time develop into columnar supports to an immense head of the tree, resembling a number of trees, planted side by side and joined at the top. The leaves are

large, leathery, shiny and plentiful casting too heavy a shade for anything to grow under. Bright crimson berries are borne usually in August–September. Suited only for planting in most spacious locations.

Ficus elastica: Indian Rubber Tree. A sturdy very large quick growing, spreading tree reaching a height of more than 15 metres and clothed, with oval, large, leathery, smooth, shining leaves. The young leaves are enclosed in pinkish stipules which gives a colourful appearance to the tree. Best suited for places with heavy rainfall. A *variegated species* of the above, with yellow markings and blotches on the leaves and growing only to a small size is excellently suited for planting on lawns.

Ficus retusa: Called the Chinese Banyan, has leaves smaller than the Bengal Banyan. Also makes a heavy shade tree and has aerial roots like the other Banyans. All the above species are propagated from cuttings.

* *Filicium decipiens*: See page 260.

Kigelia pinnata: See page 247.

Parkia: A very ornamental large shade tree. See page 251.

* *Peltophorum ferrugineum*: An excellent shade tree with a wide spread. See page 251.

Pithecolobium Saman: The Rain Tree. A large, wide-spreading, tree of very rapid growth, very suitable for shade in a large garden. The branches are easily broken by strong winds. Propagated by cuttings or seed.

Polyalthia longifolia: See page 262.

Pongamia glabra: (*Leguminosae*): (Canarese: 'Honge'; Tamil: 'Punga'; 'Karanj'; 'Dalkaramcha'). A partially deciduous, medium-sized, useful tree with shining dark green leaves, bearing pendent racemes of lilac flowers. The flowers are used in a well decomposed state for forcing Chrysanthemums and such other plants, which require heavy and rich feeding. A useful oil is extracted from the seeds, and the oil-cake is used extensively as manure. Leaves make excellent green manure. The trees may be planted close and pruned to form a tall hedge.

Swietenia Mahagoni. (*Meliaceae*): The famous Mahogany Tree; evergreen, good-looking, tall, large, very slow growing, giving fairly good shade; attractive foliage of small pinnate leaves. Easily propagated from seed.

S. macrophylla is larger leaved than the preceding species and is a faster grower.

Tectona grandis. (*Verbenaceae*): The Teak Tree. It is a truly grand and majestic tree with large leaves. In large gardens it can be planted for shade. The tree is very handsome in bloom with large erect loose bunches of flowers.

Terminalia catappa: See page 264.

CHAPTER XVIII

SHRUBS

List A includes select shrubs grown for their flowers. List B includes select shrubs grown for their ornamental foliage or handsome form or both.

For general remarks on shrubs and shrubberies and the care to be taken of them see pages 175-176. For directions as to planting and transplanting shrubs, see Chapter VII. For general directions for pruning ornamental and flowering shrubs see Chapter X.

(A) SELECT FLOWERING SHRUBS

Abelia Grandiflora. (*Caprifoliaceae*): A bushy shrub, 1½ to 2 metres high with glossy, bronzy green foliage. The flowers are white, scented and borne in summer months in clusters. After the flowers have fallen, the brown sepals remain on the plant and are attractive. Prefers a semi-sheltered position and well drained soil.

The above species and *A. chinensis* and *A. rupestris* are all suited only for medium to high elevations. All are propagated from cutting.

Abutilon. (*Malvaceae*): Known as Flowering Maple or Chinese Bell Flower or Chinese Lantern. A class of showy herbaceous, free growing shrubs, 1 to 1½ meters with long-stalked, often maple-like leaves. The flowers are Hibiscus-like but pendulous like ear drops. Some kinds are grown for their variegated foliage, as for instance *A. Thompsonii*. Abutilons grow but do not freely flower in the plains as at medium to high elevations. Propagated by seed and cuttings. Soak the seeds in water for about two hours before sowing. Sow them thin, to facilitate thinning, as germination is irregular. The time for sowing is October in the plains and March on the Hills. When the seedlings are big enough to be handled, when they are about 2½ cms. high, put them into small pots in rich loam, in such a way that the seed-leaves rest on the soil.

Ensure thorough drainage, Shift them to larger sized pots as they grow and fill the pots they are in with roots. Pinch back the shoots to bush the plants out. Cut back old plants for fresh growths. They are best discarded in favour of new plants raised from seeds or cuttings. Adutilons require more or less shade and shelter from wind and rain.

A. indicum with yellow flowers is suited for the plains. The following attractive varieties are suited for medium to high elevations:— *A. Sawitzii* bears ornamental green and white foliage. *A. aureum variegatum* has foliage spotted and splashed with yellow. *A. Boule de Neige* bears white flowers. Double flowers of orange shaded with crimson are borne in *A. Thompsonii plenum*.

Acacia. (*Leguminosae*). A large genus of very useful ornamental shrubs and trees, popularly known as 'Wattle'. They are quick growing but shortlived plants, thriving from medium to high elevations only, except *A. Farnesiana* which grows well in the plains as well. The genus furnishes plants of great economic value. Some species furnish scented flowers from which fine perfumes are manufactured. *A. senegalensis* furnishes the famous gum-arabic of commerce. *A. concinna* furnishes the soap-nut pods, which are powdered and largely used in India. Some other species furnish strong wood, from which furniture is made. The trees, *A. dealbata*, *A. longifolia*, and *A. decurrens* have been mentioned under trees page 235. *A. Farnesiana*, called the Fragrant Acacia, (Can: 'Kasturi Jali'; Hindi: 'Vilayati Kikar or Babool' is a large thorny, (the name Acacia is derived from a word meaning a point or a thorn, referring to stipules, which are often spinescent), spreading unattractive bush or small tree bearing very highly scented globular and tassel-like yellow flowers, in great profusion in the cold season. Flowers retain their smell long after they are gathered. A valuable perfume called opopanax is made out of the flowers in France. Dried flowers make wonderful sachets for scenting clothing. The shrub makes a good fence if cut and trimmed now and then.

* **Acalypha.** (*Euphorbiaceae*). *A. hispida* = *A. sandari* is different in character from the other species of Acalypha, which are grown for their variegated pretty foliage. it is a small

shrub grown for its long drooping spikes (catkins) of crimson flowers. The leaves are broad and dark green in colour. The plant can be trained to a single stem or to a spreading bush form; it is serviceable as a pot plant too. Propagated by cuttings. *A. Sanderi* var. *alba* bears creamy white spikes. Thrives best in semi-shade.

**A. colorata* has brown tinged leaves and bears longer catkins.

Acanthus. (*Acanthaceae*).

**Acanthus angustifolius* is a herbaceous perennial shrub, $\frac{1}{2}$ to 1 metre high, with pretty shining leaves and rosy spikes of flowers. The plant thrives in semi-shade and is very handsome, being full of flowers in the rainy season.

A. ilicifolius is also a pretty shrub about 1 metre high bearing light blue flowers and large Holly-like prickly leaves. Likes plenty of water and is best suited for swampy ground.

A. montanus grows $\frac{3}{4}$ to 1 metre high, with handsome large oval, pinnatifid, holly-like spiny leaves which are a foot or more in length. Rose-pink flowers are produced in long spikes. Propagated by seeds or cutting.

***Achania.** (*Malvaceae*) : *Achania malvaviscus*. A pretty Hibiscus-like shrub with small half opened intensely bright scarlet Hibiscus-like flowers borne throughout the year. **A. leschenaultii* (*conzatti*) bears flowers nearly three times the size of the preceding species and has hence superceded it as a garden variety. Can be trained as a very ornamental standard; can be grown as a bush on the lawn; can be planted closely and trimmed to make a very attractive hedge. Easily raised from cuttings.

Adeneum Obesum. (*Apocynaceae*) : Very handsome plants with a succulent stem, swollen at the base. It is a tall erect shrub up to 2 to 3 metres, branches also succulent very slow growing, most suited as a pot plant or for a Rock garden. Very large showy funnel shaped flowers of pink to crimson about 6 cms. across with prominent longitudinal reddish stripes; blooming terminally, from May to October.

***Aerua Tomentosa.** (*Amaranthaceae*) : Small, very pretty, shrub $\frac{1}{2}$ to 1 metre high, with wooly silvery leaves and long dense attractive spikes of white flowers. Effective in the

shrubbery or herbaceous border. Also useful as a pot plant. Raised from cuttings or seed.

Aglaia odorata. (*Meliaceae*). Chinese Rice Flower. A bushy shrub, about $1\frac{1}{2}$ metres high, with fine-cut shining light green foliage. Popular with the Chinese for its clusters of delightfully fragrant yellow flowers of the size of a pin's head borne during hot and rainy seasons and used by them for scenting their teas. Can be used for a hedge. Useful as part of a large shrubbery. Raised from cuttings.

Allamanda. (*Apocynaceae*). An important genus of showy tropical shrubs, chiefly from South America. They are mostly climbers or scandent shrubs, which are evergreen, with dark polished green leaves. The flowers are terminal, large, and funnel-shaped, with a flat spreading or reflexed limb. Allamandas are all very hardy and thrive in the plains and are easy to cultivate. They should be pruned now and then to keep them within bounds and they can be gracefully trained over some support or a 'pandal' to effectively show themselves off. Propagated by cuttings of mature wood or layers.

All the species except *A. violacea* and *A. nerifolia* are varieties of one variable species. **A. grandiflora* is a choice gorgeous climber, which can be trained over a porch, trellis or arch. It can also be grown on the lawn as a shrub with some support for the scandent branches to go up and gracefully come down. Large yellow funnel-shaped flowers are produced in great profusion throughout the year and especially in summer and in August-September. The flowers contrast well with the deep green, highly polished leaves. **A. Aubletti* climbs widely and flowers profusely. *A. cathartica* is of less scandent habit than the preceding kind and its flowers are smaller. *A. cathartica* variety *Hendersonii* is another pretty kind. *A. nerifolia* is a dwarf bush about 1 metre high, is distinct from the other species in its dwarf habit, its foliage and golden coloured corolla which is streaked with orange. Seeds profusely. **A. violacea* = *A. purpurea* is distinct from the other species. It is less a climber than others, grows $1\frac{1}{2}$ to 2 metres, is rather less common than the other species. Bears pretty bright reddish purple flowers, with the tube 5 cms. long, and the limb spreading and 5 to 6 cms. in diameter. Its root system is not strong and it is

difficult to propagate from cuttings. Best grafted on *A. grandiflora*.

Aphelandra. (*Acanthaceae*): Handsome shrubs resembling *Justicia*, easily raised from cuttings.

A. cristata = *tetragona* grows to about 1 metre, has lanceolate taper-pointed leaves which are 17.5 to 20 cms. long, bears in March on the summits of the shoots spikes of brilliant scarlet flowers.

Ardisia. (*Myrsinaceae*): Flowering evergreen shrubs, which are grown for the beauty of their berries. The word *Ardisia* is from *ardis*, a point, in allusion to the pointed anthers. As lower leaves are lost in course of time, the shrubs are best pruned back for fresh growths. Propagated by seed.

Ardisia humilis: (Canarese: 'Kantena bodina gida'; Hindi: 'Kadna-banjam') is an erect shrub, having leathery leaves and bearing pendulous umbels of pink flowers, which are succeeded by blackish berries. *A. crenulata* is a dwarf shrub 90 to 120 cms. which is grown for its pretty large clusters of bright red berries following small white flowers. Useful as a pot plant, in borders, and on the rockery. There are other attractive species such as *A. paniculata* with rose coloured flowers and red berries and *A. umbellata* with pink flowers and purple berries.

Artabotrys odoratissima. (*Anonaceae*): (Canarese and Tamil: 'Manorangini'; Hindi: 'Hara-champa' = Kantali champa). The word is derived from *Artao* meaning to suspend and *botrys* meaning a bunch, the peduncle is so constructed that it holds a bunch of suspended fruit; *odoratissimus*, means most scented. A large climbing dense evergreen shrub, with very pretty glossy leaves and thick fleshy, very strongly scented flowers, which are green and turn yellow on ripening. The shrub is very hardy, thrives in any soil, and is very useful for screen planting in large gardens. It can be trained to an umbrella form like a large standard. Propagated from seeds or by layers.

Aclepias curassavica. (*Asclepiadaceae*): A herbaceous milk-juiced perennial shrub, known as the Blood Flower or Milk-weed or Silk-weed. It grows 75 to 90 cms. high, and has downy, lanceolate leaves and bears Lantana-like, terminal erect umbels of bright orange-yellow flowers throughout the hot weather. The shrub self-sows itself and grows like a weed

anywhere, especially in dry regions. Cut back for bushing out when stems are lanky. Propagated by seeds or cuttings. Old plants are best discarded and replaced by newly raised plants. Makes a good pot plant.

A. lutea bears yellow flowers.

Asystasia coromandeliana. (*Acanthaceae*): A weedy herbaceous plant about 45 cms. high with a trailing habit bearing numerous white or cream coloured flowers with a yellowish tube. As it withstands adverse conditions, it may be used as ground cover in difficult situations. Thrives best in partial shade. Useful in a rockery.

A. Travancoreana bears purplish flowers.

There are several varieties with white, rose, cream or blue coloured flowers. All are propagated from terminal cuttings or from seed.

A. bella upright sub-shrub about 1 metre high, terminal racemes of lilac coloured, bell shaped flowers.

A. chelonoides bears purple flowers in branching terminal racemes. Both the above species are useful for pot culture or in herbaceous or mixed borders.

Azalea. (*Ericaceae*): Handsome shrubs, 60 to 150 cms. high, suitable for a pot culture or open ground, thriving only at hill stations as Coonoor and Ootacamund. The Chinese Azaleas are free flowering and are available in a wide range of colours—white, pink, red, scarlet, rose, magenta, purple—in single and double flowering varieties. They need extra care and special attention in cultivation. They should be planted in sheltered situations in well worked light soil with leaf mould incorporated into it. Strong manures should be avoided. The plants have a positive aversion to limy or chalky soil. Propagated by layers, division or seeds.

Barleria. (*Acanthaceae*): (Canarese and Tamil: 'Spatika'; Hindi: 'Jhate'). Group of attractive small evergreen shrubs 60 to 120 cms. in height, being loaded with bell-shaped beautiful flowers in the rainy season. The plants bloom almost throughout the year by pruning them back every time after flowering. They are very desirable for mixed borders and for ornamental small hedges. The flowers are largely used for puja purposes. There are several species with pure white, rose,

blue, orange and variegated flowers, and in all of them the dry bracts of the flowers remain long after the flowers are gone. Easily raised by cuttings or seeds. The following species are highly recommended :—

**B. cristata* bears violet-blue flowers. There are hybrids bearing variegated mauve and white, white, pink and rose-coloured flowers.

B. Gibsonii: At branching glabrous shrub has large azure-blue flowers.

B. prionitis is shrubby is armed with axillary sharp spikes and bears large orange-coloured flowers.

Bauhinia. (*Leguminosae*): (Hindi : 'Kuchnar'). A genus consisting of large shrubs and trees. The latter have been considered in pages 236-237. The following shrubs are noteworthy :—

**B. Galpinii* is a large spreading shrub from South Africa with small camel-footed leaves. It grows to 1½ to 2 metres or more and bears very showy, large clusters of brick-red flowers, in very great profusion covering the shrub in a mass of colour. The shrub is in bloom almost throughout the year but it is particularly handsome in February and April.

B. tomentosa. See page 237.

B. acuminata is a pretty shrub, 1½ to 2 metres high, with white flowers, borne almost throughout the year.

***Beloperone Amherstiae.** (*Acanthaceae*): Handsome small shrub, 90 to 120 cms. high, which is nearly always in blossom with large fresh pink flowers produced at the nodes. It is allied to *Justicia* and requires the same treatment. Raised by cuttings or seeds.

B. guttata. (*Shrimp plant*): Attractive Mexican plant useful for decorative work due to its bushy and graceful habit. The small whitish pink flowers are almost concealed by reddish brown bracts, which overlap each stem to form an attractive inflorescence. Propagated by cuttings. Ideal plant for beds and pots. About 60 cms. Brightness the herbaceous mixed border, practically throughout the year.

Bougainvillea. (*Nyctagineae*): Named after De Bougainville, a French navigator. A genus of South American vigorous growing heavy-climbing shrubs; very attractive with their

brightly coloured bracteal flowers and growing very easily in any soil with very little attention. The flowers are small and inconspicuous but the decorative value of the plants consists in the fact that the flowers are inclosed in large and showy brightly coloured bracts. Bougainvilleas enjoy full sunshine, are of rampant growth, and form very attractive hedging and fencing plants. A natural boundary fence of Bougainvillea, kept neat and tidy by regular use of the shears, is a glorious sight when in bloom. Allowed to climb up a tree, it rapidly covers the tree, the whole tree appearing one blaze of colour in the proper season in course of time. As bushes or large shrubs, frequently kept down by severe pruning and trimmed to a certain form, they are very ornamental. Standard Bougainvilleas, 1 to 1½ metres high, planted alongside roads or walks are magnificent in bloom. Bougainvilleas are also useful to cover trellises, porches etc. They are very serviceable as pot plants too, making excellent specimens of bright colourful masses. For this purpose, young plants grown from cuttings are put in 30 cms. pots and grown bushy and compact by frequent removal of water shoots and pruning back straggling branches. About three months before the blooms are desired, the plants are very sparingly watered, starving them so that all the leaves wither and fall away. If the plants are again liberally watered, new growths appear soon with a mass of colour. Propagated from cuttings and layers and from seeds for new varieties.

Bougainvilleas roughly fall into two groups, the glabrous and the soft hairy-leaved. The glabrous leaved type is hardy withstanding a certain amount of frost and suitable for trials at higher elevations. It is easily propagated from cuttings. It is more or less perpetual flowering and is better suited for pot culture than the hairy-leaved type, which is best planted out and allowed to grow freely to produce masses of colour.

The following are the most noteworthy species. Those with distinctly hairy leaves are marked (h): Others are either distinctly glabrous or possess leaves very slightly hairy.

B. Spectabilis. (h): A rampant grower. Usually in bloom from February to April. Rosy purple bracts in large panicles.

B. speciosa. (h): Very showy large purplish mauve bright bracts.

B. rosea=*B. rosa catallina*: Very large rose coloured bracts.

B. Gopal (Semi-hairy): A new variety raised by the author and named after himself. Large bracts similar to those of *B. rosea* but brightened with suffusion of very light mauve colour. Makes an excellent pot plant, flowering continuously for a long time twice a year. Conspicuous on the lawn.

B. laterita (h): Attractive brick-red bracts.

B. braziliensis. (h): Almost like *B. laterita*, with bracts of lighter colour and more longish in shape.

B. "Pink Beauty" (h): A good dwarf growing variety, introduced by the Soundarya Nursery. Bracts are bright carmine pink.

B. Red Glory. (Semi-hairy): A new variety introduced by the author. Bracts showy, bright deep red. Makes a good pot plant.

B. Maharaja of Mysore (h): Small bracts of pale rose with a tinge of light mauve. Shoots are slender.

B. Mrs. Fraser. (Semi-hairy): Pale teracotta pink bracts. Bushes amenable to clipping.

B. glabra: Distinctly glabrous leaves. Pale mauve bracts. Constant bloomer. Useful for hedging.

B. glabra var. *Sanderiana*: Almost like the above but with a definite dwarf habit of growth and more floriferous.

B. cypheri: Magenta bracts. Free bloomer.

B. refulgens: Purple mauve bracts. A perpetual bloomer.

B. magnifica: Large bright mauve-magenta bracts. A shrubby kind, almost always in bloom.

B. magnifica var. *treillii*. Bracts slightly smaller than in the above. Has a most trailing habit.

B. formosa: Pale rosy mauve bracts produced in heavy very attractive long sprays. Blooms throughout the year. One defect of this kind is that the old bracts do not fall off. This is a very ornamental species introduced to Bangalore by Thomas Royar, once a propagator and later, curator in Lalbagh, the Government Botanical Gardens. He brought a small branch

with a bunch of flower from Ceylon, succeeded in propagating it as a cutting in a hot bed and frame, and presented the plant to the author, who planted it in his garden and raised a number of plants by layering. He distributed some to the gardens in Bangalore, sent some to the Agri-horticultural Society of India at Calcutta, and some to the Agri-horticultural Society, at Madras, and to other centres. This species has become very popular all over India.

B. Lady Hudson=B. Princess Margaret Rose. Bright light pink bracts. Showy. In bloom throughout the year.

B. Mahatma Gandhi. A new variety raised by the author and named after the father of nation in February 1948. The bracts are very large and are of a colour difficult to describe. They are glowing pink with a faint suffusion of purple which enhances the colour effect. The blooms are produced in yard-long faggot-like stands, reminiscent of variety *B. formosa*. Best as a tall standard with its arching long shoots ending in long sprays of masses of colour.

B. Partha, also an outstanding kind raised by the author, named after his son. Perpetually in bloom with long sprays, over 7 to 5 cms. long, carried over arching shoots, and containing bracts of two distinct colour, orange and pink-purple (a shade deeper than that of *B. Mahatma Gandhi*). The orange bracts are at the tips of the sprays and the others at the base of the sprays. A remarkably noteworthy species. Striking, grown as a tall standard.

B. Scarlet Queen and B. Mrs. Butt: Bracts of crimson-scarlet. Striking and always in bloom.

B. Jaya Laxmi: A great improvement over the preceding species. Bracts are more freely produced and they are distinctly of a lighter colour suffused with rose colour. Always in bloom. Makes a splendid tub plant. Raised by the author and named after his daughter.

B. Louis Wathen=B. Orange Glory: A sport from *B. Mrs. Butt*, raised and fixed by the wife of an Agent of the M. & S. M. Railway Co., in her garden and named after her. It is not unusual to find plants of this species bearing one or two shoots with bracts of the original species, namely, *B. Mrs. Butt*.

B. Mrs. Butt (Rangoon) = Purple Mrs. Butt. Also called

the *Purple Queen*, is another sport from Mrs. Butt with deep crimson-purple bracts. Also a free bloomer.

B. Meera. Bracts larger and deeper in colour than in Mrs. Butt. Not so free in blooming as Mrs. Butt. Introduced by a keen amateur gardener, A. R. Rangachari, of Madras. Named after his pet child.

Since the last edition of the book was brought out several hybrids in *Bougainvillea* have been introduced in varying colours.

Boise de Rose : A new colour in Rose.

Cascade : Rosy pink bracts in bunches like cascades.

Fantasy : Attractive new colour with light rose bracts with occasional red streaks.

Flame : Very outstanding and unusual with orange and yellow bracts.

Gem : Rose to rose carmine, ideally suited for hedge.

Happiness : (*KSG's introduction*). Really brings happiness to one's heart with its charming huge bracts of carmine tinged with light orange when young turning bright orange-red.

Dr. Hado : Deep magenta, perpetual blooming dwarf, can be grown as a small hedge.

Krumbiegal : (*KSG's introduction*). Named after the famous Horticulturist gives out huge light purple, striking and appealing new colour.

Lalbagh : Bright bracts of bright red to orange.

Lateretia : Bright orange and brick red bracts.

Lilac Queen : (*KSG's introduction*). Pleasing rosy mauve brighter and bigger than *Farmosa* and the bracts do not sticks to the plant when old as in *Farmosa*.

Lady Hope : Pale rosy pink bracts very attractive.

Mary Palmer : Bracts of shining magenta pink and white in the same plant are produced. This is a profuse bloomer and very well suited as a tall standard. Sport of M. Gandhi.

Orange Sceptre : (*KSG's introduction*). Bright orange with light tinge red in young bracts a free bloomer.

Padmini : (*KSG's introduction*). Named after author's grand daughter. Darker than *Partha* and very striking best suited to be grown as a shrub.

Purple Gem : Bright glowing pink.

Red Glory Improved : (*KSG's introduction*): An improvement over the Red Glory both in colour and brightness of the bracts.

Refulgens variegated : Variegated bracts of magenta and white not a free grower as other Bougainvilleas are.

Rhodamine : Bright magenta, long bracts, very free bloomer.

Nigrette : (*KSG's introduction*). A lovely new novelty with deepest magenta imaginable, hence the name. Very free blooming glabrous variety with great promise.

Rosea Fuschia : Gives out orange bracts turning red.

Satchidananda : A very bright lavender mauve.

Scarlet Glory : (*KSG's introduction*). Very appealing huge bracts of scarlet orange bracts turning crimson, a free bloomer.

Phillips No. 1 : Garnet brown to rose opal to purple.

Sweet-heart : Very beautiful light magenta tinged pink.

Trinidad : Very pale pink with tinge of mauve.

White and Snow Queen : White coloured bracts, profuse bloomer.

Mrs. Enid Lancaster : (*Yellow Queen*). Yellowish bracts turning to light orange.

Versicolour : A dazzling orange red.

Srinivasa : (*KSG's introduction*) : Named after the author's father. A new hybrid with huge bracts of orange scarlet changing to crimson and carmine giving it a charming multicoloured effect. The bracts are rounded at the tip reflexing with prominent veins, a spectacular variety.

Kalyani : (*KSG's new introduction*). A lovely new hybrid, named after author's wife with huge rosepink to carmine bracts turning pale as the bloom ages with prominent veins. A beautiful variety flowering plentifully.

African varieties of Bougainvilleas : These are some of the very pretty bougainvilleas to date, free flowering and most of them are in bloom throughout the year.

Blondie : One of the loveliest varieties, bracts looking almost like paper flowers, colour being very luminous light

carmine orange to carmine red paling as the bracts age giving a very unusual enchanting shade.

Jennifer Fernie: The best white to date the bracts are recurved.

Lady Mary Baring: Bracts of Indian yellow with greenish veins. Corolla tinged with orange blooms borne in huge trusses more at the ends of the branches. A vigorous grower. Best suited as tall standard and a single specimen.

Golden Glow: Youngs bracts of Majolica colour yellow, latter turning to Cadmium orange and finally to light carmine. Free flowering, borne in clusters at the end of the branches.

Margery Llyod: Long bracts of brick or rust coloured, vigorous and free flowering variety.

Netalli: An unusual cultivar with drooping branches and fragile growth. Bracts of spinal pink to dawn pink in colour. Mid-rib prominently green. Blooms borne in huge pendulous clusters which are very beautiful.

Isable Greensmith: Brilliant erect bracts of Jasper red changing to rose pink, free flowering.

Poultoni Special: One of the biggest bracted Bougainvilleas. Salferino purple colour and the bracts are twisted and clasping each other.

Killie Campbell: Thin bracts of copery red maturing to bright red and fading to cerise. Gives a delightful tricolour effect.

Glady's Hepburn: Big bracts of Tyrian rose, greenish when they are tender.

No. 2: Big bracts of plox purple and blooms borne in huge clusters at the ends of the branches.

Elizabeth: Small bracts of Dianthus purple. Blooms borne heavily at the ends of the branches.

Asia: Small, beautiful bracts of magenta crimson.

Brilliant: Free blooming brilliant flame colour fading to magenta.

Kayata: Attractive, heavy blooming variety with Neyron|rose bracts.

Charles Wilson: Small bracts of hot pink in colour.

Sydney: Ruffled pale purple bracts, a vigorous grower.

Ruaraka: Purple coloured with prominent thick green mid rib.

Variegated leaved varieties: These are noted for their foliage effect and also flowers.

Glabra Variegata. (African): Small elliptical and closely arranged variegated leaves with whitish or cream along the margin with two shades of green adding to its beauty, bearing flowers with whitish purple when tender and turn to purple.

Rao: Probably the prettiest of the variegated kinds, Tender leaves are pink in colour and as they expand, the mature leaves have a green patch in the centre of the leaves and whitish cream colour all along the margin. The bracts are red borne at the ends of branches. Propagation not as easy as in the case of other Bougainvilleas.

Thimma: This is a sport from Bougainvillea Mary Parlmer. In addition to pink and white coloured bracts has wide yellow patch or patches in the leaf which is very attractive. This is a remarkable vigorous growing variety which has variegation in the foliage as well as the bracts. Ideally suited as a full standard.

Sharma: This is a bud sport from Mrs. Fraser. The cream variegation is in the nature of patches in different degrees.

Velayini: Very prominent variegated leaves of cream and green at the centre bearing red flowers.

There are other variegated species from Louis Wathen, Speciose, Rose Queen and purple Mrs. Butt, also.

Multibracted Bougainvilleas have come to stay and they have been introduced through Lalbagh, Bangalore. There are three types of multi-bracted Bougainvilleas place of origin being Phillipines and are popularly known as 'Million Dollar Bougainvilleas' in Red, Magenta and Golden in colour. The red variety is called B. Mahara. The peculiarity of these varieties is that they have 20 to 30 small bracts with a common centre and the entire thing appears like a clustered-Rose flower in large clusters. The thorns in the plant are much less than in other bougainvilleas.

Brugmansia: See under Datura.

Brunfelsia: (Solanaceae): Closely allied to Franciscea.

B. americana is an erect growing showy shrub, 1½ to 2 metres high, with slender branches and dull green glabrous

leaves. It is very ornamental, nearly always in bloom, bearing in great profusion long tubular jasmine-scented pure white flowers, which change to yellow. Propagated from cuttings, layering or from seeds. Easily cultivated, thriving in sun or semi-shade. Native of West Indies.

**B. grandiflora* is a similar species with large flowers.

**B. Lindeniana* is the most attractive of *Brunfelsias*. Grows 2 to 2½ metres high. Bears larger sweet scented flowers than in *B. grandiflora* in greater profusion.

B. Hopeana = *B. uniflora* : See under *Franciscea*.

B. eximia = *Franciscea eximia* : Called 'Yesterday, Today and Tomorrow', on account of its attractive flowers, deep blue when first open, changing to pale blue on the second day and bleaching to white on the third day, all colours found on the same plant at a time.

Brya Ebenusa. (Leguminosae) : A beautiful shrub, with pendulous branches, which are covered with Golden yellow flowers.

Buddleia. (Loganiaceae) : Group of decorative and useful shrubs in the border and the shrubbery. Some of them are of a scandent habit. The leaves of some species are silvery underneath. The flowers are borne in large panicles, composed of very small flowers, which are yellow, white, lilac, or violet in colour. Propagated by cuttings and layers. They thrive well in any good garden soil. Buddleias are shy bloomers in the plains. The nomenclature of Buddleias is very much confused. The following species are recommended :—

B. asiatica is a native of Indo-Malaya. It is a very free flowering shrub, 1½ to 2 metres high, with the branches covered with white or buff tomentum and leaves whitish underneath. Drooping racemes, 7 to 15 cms. long, of small white very deliciously scented flowers are produced in great abundance during February-April. Cuttings of young growth inserted in sand root readily. The shoots should be cut back after flowers are over.

**B. Lindleyana* is a very ornamental spreading shrub, 1 to 1½ metres high, with delicately scented lilac-coloured small flowers packed in dense racemes, which are 10 to 20 cms. long. In the hot season, the racemes of flowers are

produced in unlimited profusion. Cut back after flowering to 54 cms. from the ground level. Best treated as an annual or biannual at lower elevations by raising new plants from cuttings put in the cold season. Intolerant of wet soil.

B. Davidi Vars *Veitchii* bears larger racemes than *B. Lindenii* and the flowers have an orange eye.

B. madagascariensis is a big rampant shrub, almost a climber, with stems covered with whitish tomentum. The leaves are dark green above and whitish underneath. Racemes about 15 cms. long of small orange yellow flowers are borne in abundance in January and February. The shrub is suited only for large gardens to be planted on the outskirts. Prune back severely after flowering. *B. 'white Boquet'* has white flowers.

Caesalpinia pulcherrima. (Leguminosae). Syn. *Poiaciana pulcherrima*. Popularly called the Barbados Pride or the Peacock Flower, it is a large handsome shrub, 1½ to 3 metres high, with bipinnate leaves. Erect large racemes of scarlet or orange-red flowers are produced in profusion throughout the year. A very hardy plant which thrives with little care in any garden soil. Responds to pruning and makes bushy growth, if the branches are cut back to a third of their length every year or once in two years. Easily raised from seed. Suited for hedging and for effective mass of colour in shrubbery.

C. pulcherrima var *flava*. Bears bright yellow flowers.

Calliandra. (Leguminosae). **C. haematocephala*, handsome shrub, 1 to 1½ metres high, with very graceful foliage of pinnate leaves. Beautiful in the cold season, when in full bloom, with its large bright crimson powder puff-like flowers. Propagated by cuttings or seeds. A truly handsome plant.

**C. Houstoni* is nearly always in bloom, grows 20 to 25 cms. high bearing scarlet tassel-like flowers.

Callistemon. See page 239.

****Camellia.*** (Ternstroemiaceae): Charming slow growing evergreen shrub, bearing exquisite wax-like flowers of great beauty and perfection. The leaves are dark green and glossy. Suited for medium to high elevations. At medium elevations, the shrub is grown in partial shade in large pots like *Hydrangea*. It prefers an acid soil rich in humus and

hence a compost consisting of a large proportion of well decomposed leafmould with good loam is necessary. It likes a humid atmosphere and so overhead spraying with clear water is desirable. It should be pruned after flowering. Propagated by seeds, cuttings or layers. **C. japonica* is the commonly grown species with double flowers, white, rose or pink in colour.

***Carissa carandas*:** See page 195.

***Cassia alata*.** (Leguminosae): A fine shrub with large ovate leaves and cone shaped spikes of deep yellow flowers. Flowers crushed and mixed with lime juice is an excellent remedy for ring worm.

***Catesbaea spinosa*.** (Rubiaceae): Lily Thorn. Medium-sized thorny shrub with Myrtle-like leaves. Greenish yellow, trumpet-shaped large flowers, 7 to 10 cms. long, hang down in a peculiar way, as if they are simply suspended from nowhere and are kept there. Native of South America. Propagated by cuttings during the rains or by layers.

***Cestrum*.** (Solanaceae): A genus of ornamental easily cultivated shrubs with attractive foliage and flowers that appeal either by their fragrance or colour. To prevent them from becoming ragged, they require to be pruned back. Propagated by seeds, cuttings or layers.

**C. nocturnum*, popularly known as the Queen of the Night is a large evergreen straggling shrub, 1½ to 2 metres high flowering twice or thrice a year. The flowers are small and pale green in colour and are produced in clusters drooping down the plant on account of their weight. The scent of the blooms is so strong that the presence of the plant is felt at a great distance. Very commonly grown for the delicious fragrance of the flowers.

**C. aurantiacum* is a large evergreen shrub 1½ to 2½ metres high, with oval undulated leaves. The flowers are tubular, one inch in length and of a bright orange-yellow colour and produced in showy clusters in great profusion in early summer. After flowering, the plant should be pruned back for abundance of fresh wood which will flower the following year. Wants liberal supply of water.

C. elegans = *Habrothamnus elegans* is another attractive

species, 1 to 1½ metres high similar to the preceding species but bearing purple-red flowers and also purple berries in clusters. *C. aurantiacum* and *C. elegans* do not thrive in the plains, unlike *C. nocturnum*.

C. diurnum, called the Day Queen bears white flowers in small clusters, scented during the day. Evergreen polished leaves. 1½ to 2½ metres high.

Citharexylon fruticosum. See page 243. A large shrub or a small tree.

Clerodendron. (Verbenaceae) : A large genus including some very ornamental shrubs and climbers, which are easy to cultivate in any good garden soil. The flowers are produced at the ends of fresh growths and hence the old shoots should be cut back three to six buds from the base. Propagated by suckers or offsets, cuttings, seeds.

C. fragrans var *plena* is a vigorous growing large coarse-leaved shrub 1 to 2 metres high, bearing almost always erect terminal compact heads which are composed of double, jasmine-like, scented, white flowers about 10 cms. across flushed pink. The shrub should be cut back every year for bushy appearance. The foliage of unpleasant smell to handle. It throws out suckers from the roots at long distances from it and hence is not quite desirable near other ornamental shrubs.

**C. Kacmpferi* is 1½ to 2 metres high, is very showy, has large, roundish, rough leaves and bears brilliant scarlet flowers in large clusters surmounting the leaves at the ends of the new shoots. The blooms last for a very long time, as long as two months and a half, and the shrub is worth growing in every garden. Fresh plants thrive well and they are easily made by terminal cuttings. Likes partial shade. Makes a good plant in a large pot.

**C. fallax* is a highly ornamental species, about 1 metre high, with large dark green leaves. The flowers are bright scarlet in colour, 3 to 5 cms. in diameter, produced in clusters, which are often 45 cms. or more in length. The plant wants slight shade from sun. Native of Java and easily grown from seed.

**C. phlomoides* : Very pretty with its erect large clusters of conspicuous white flowers, with prominent stamens.

Grows about 1 metre high, forms clumps with numbers of suckers from below. Propagated easily by division of suckers.

**C. Minahasse* from Singapore. Bears long tubular flowers above fairly large handsome foliage. Grows $1\frac{1}{2}$ to $2\frac{1}{2}$ metres high.

**C. macrosiphon* is another pretty species about, 1 metre high. Flowers, long delicate, tubular, white with large purplish stamens and lasting for a day only.

**C. nutans* is an evergreen shrub, $1\frac{1}{2}$ to 2 metres high, very handsome in August-September with abundant, pretty tubular, pale white flowers in long drooping racemes. Dark green foliage 7 to 15 cms. long.

**C. siphonanthus* grows erect to about 3 metres. Likes partial shade. An Attractive against a wall with its long linear leaves and long white tubular white flowers in large heads hanging from the upright shoots. Flowers are followed by conspicuous reddish fruits which turn purple later.

**C. paniculatum*: Pagoda Flower. Native of Java. $1\frac{1}{2}$ to 2 metres high. Large showy leaves. Large erect showy scarlet panicles.

C. Wallichii: A blue flowering species in the rainy season.

**C. ugandense*: A blue flowering handsome species. Pretty evergreen shrub, 1 to $1\frac{1}{2}$ metres high. Flowers in terminal racemes from July to November.

Crossandra. (Acanthaceae): Small evergreen shrubs, 45 to 60 cms. high with pretty spikes of orange-yellow or yellow flowers, borne almost throughout the year. They are used for puja and for head adornment by women. Subject to attacks of plant-bugs and scales and hence advisable to raise fresh young plants once every two years from cuttings or from seeds.

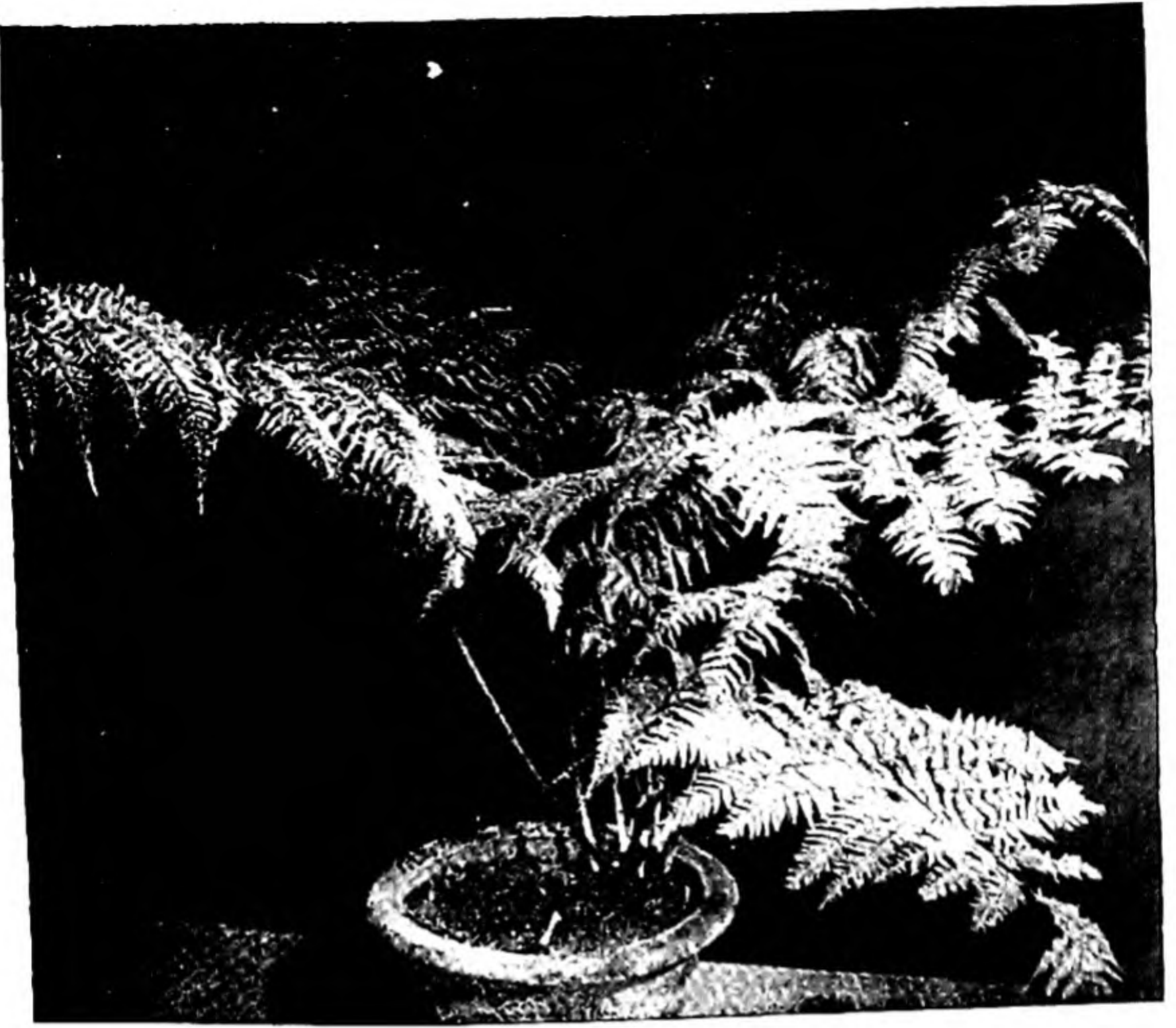
**C. undulacfolia*: Light orange coloured flowers. Seeds profusely.

**C. flava*: Yellow flowers.

C. nilotica is another handsome species.

C. Mahatma: Very showy saffron yellow flowers.

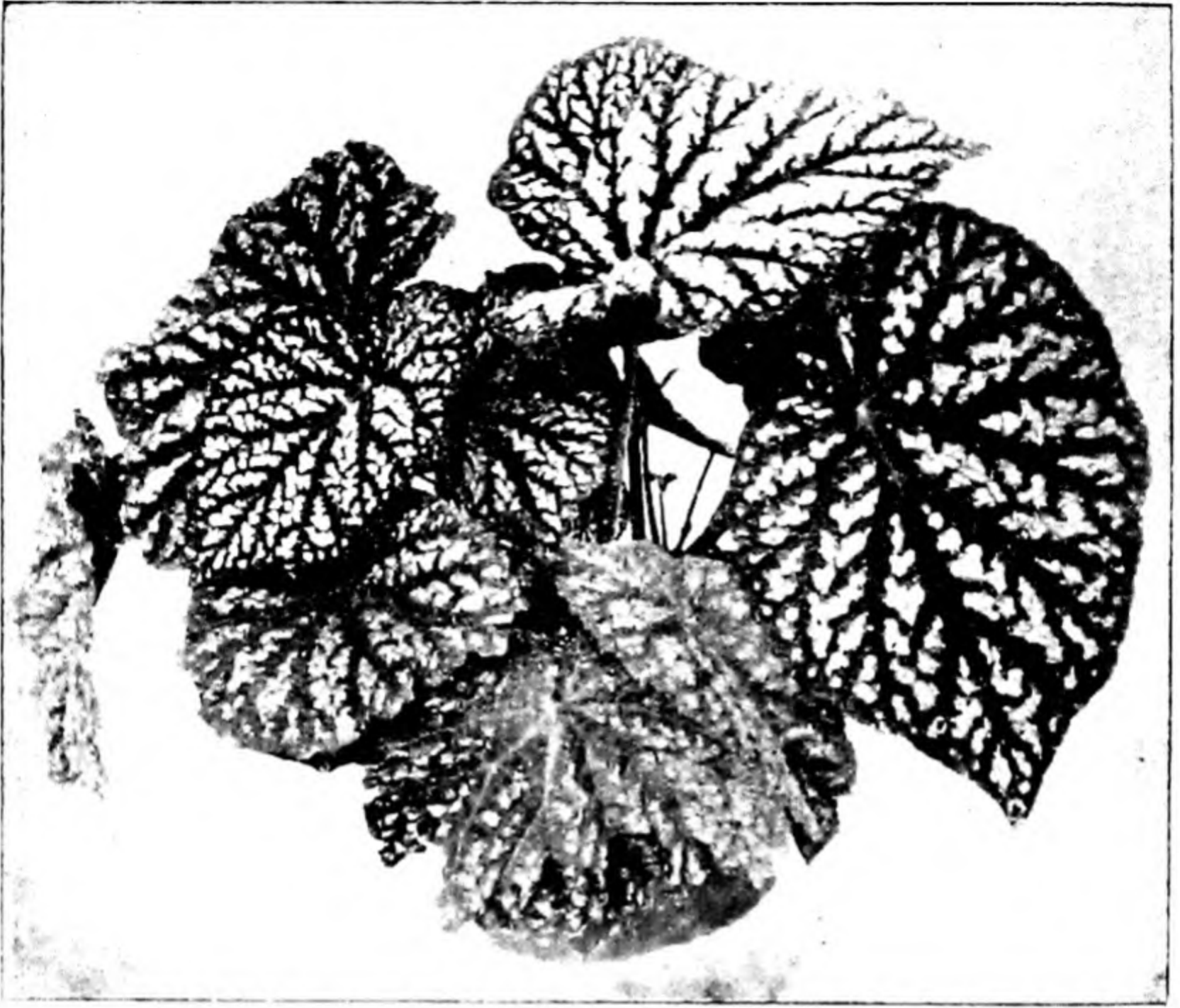
C. Soundarya: Best of the crossandras; very free flowering bright salmon orange.



NEPHRODIUM SETIGERUM



NEPHROLEPIS DUFFII



REN BEGONIAS



ZINNIA LINEARIS

Crotalaria. (Leguminosae): Rattlewort. Weedy looking shrubs, $\frac{1}{2}$ to 1 metre high, bearing Lupin-like flowers. Easily raised from seed and growing without care.

C. juncea, the common Sunn Hemp plant, from which fibre is manufactured and which is extensively used for green manuring is pretty in September with its bright yellow flowers. To serve as green manure, the seeds are thickly sown in the ground intended to be planted with choice crops at the beginning of the monsoon and the plants are dug in August. This enriches the soil and keeps down weeds.

C. laburnifolia: Pale yellow flowers.

C. pulcherrima: Golden yellow flowers. Makes a good show in December.

Cuphea jorullensis. (Lythraceae): A small shrub, $\frac{1}{2}$ to $\frac{3}{4}$ metres high, with bright orange-tipped yellow tubular cigar-like flowers. Useful in herbaceous border and as a pot plant. Propagated by cuttings or by division.

* **Daedalacanthus nervosus.** (Acanthaceae): Hardy evergreen shrub, $\frac{1}{2}$ to 1 metre high, producing spikes of rich blue colour. Makes good ornamental hedging. Some of its forms are quite desirable shrubs. *D. nervosus* var. *purpurea*, $\frac{1}{2}$ metre, purple flowers; *D. nervosus* var. *Wattii*, 20 to 30 cms., dark purple flowers; *D. nervosus* var. *latifolia*, $1\frac{1}{2}$ metres, blue flowers. All are easily propagated from cuttings. All are subject to attacks of scale insect.

Datura. (Solanaceae). (Canarese and Tamil: 'Ummatti'). There are many species of *Datura* which are indigenous and grow wild but are nevertheless handsome with their large trumpet-shaped flowers. But they are not quite so good as to be cultivated in gardens as the following species:—

* *D. suaveolens* (*Brugmansia suaveolens*). Known as Trumpet Flower or "Angel's Trumpet". A commonly grown spreading shrub, $1\frac{1}{2}$ to 2 metres high, with large, elliptical-acuminate leaves, bearing sweet scented, large, trumpet-shaped, snowy white flowers 2 to $2\frac{1}{2}$ metres long, hanging down the branches in great profusion. The shrubs are very pretty when in bloom. Prune after each flowering for fresh growths. Easily propagated from cuttings and grown without trouble. Prefers a little shady situation.

Replace the old with new plants once in every two years. There is also a pretty double flowered form, *D. Knightii* suited better for medium elevations. Natives of Peru, Mexico and Chili.

D. sanguinea (*B. sanguinea*) is a smaller shrub than the preceding species, more difficult to grow, and bearing pendulous, brilliant, orange-red flowers, which are about 2 metres long. Propagated from cuttings, which are slow to strike root. Both single and double flowered varieties are available.

D. chlorantha bears large yellow pendulous double flowers and grows $1\frac{1}{2}$ to 2 metres high. Grown from seed.

Dombeya. (*Sterculiaceae*): Genus of large quick growing dense packed shrubs, very handsome in bloom in November-January when they are one mass of colour. The flowers are borne in plenty and they are closely packed in erect corymbs at the ends of new shoots. The shrubs should be cut back to $\frac{1}{2}$ metre from the ground level every year in February or soon after the flowers are over. Easily raised from cuttings.

The following species are important:—

* *D. spectabilis* is $1\frac{1}{2}$ to $2\frac{1}{2}$ metres high, bears deep pink very handsome flowers, A truly handsome species.

D. angulata grows 2 to $2\frac{1}{2}$ metres and bears rose pink and salmon flowers.

* *D. Lancasterii* bears light pink flowers.

D. alba magnifica bears large white flowers.

D. Mastersii grows 1 to $1\frac{1}{2}$ metres bearing scented white with slight rose tinged flowers.

* *D. natalensis* bears pure white, large, sweet scented flowers; 1 to $1\frac{1}{2}$ metres high.

D. Gagliana grows very tall about $2\frac{1}{2}$ metres and has a very ornamental foliage of large roundish leaves. The flowers are pink and hang down peculiarly from the ends of shoots in huge bunches. Would be very attractive, trained as a standard.

Duranta. (*Verbenaceae*): *Duranta Plumieri* is a large, woody spreading, tall, shrub from the West Indies. It is very attractive with its bright evergreen foliage producing abundant blue flowers in long drooping racemes which are succeeded by yellow berries, hanging in clusters. *Duranta* is very useful

for hedging, as it is handsome and stands trimming well. It is also very attractive in a mixed border of shrubs. Easily propagated from seed or by cuttings. A variety Lady Stanley bears blue flowers. The white flowered, *variety alba*, is very handsome and striking with pure white flowers. There is a variety with very pretty variegated foliage with gold stripes and edges, bearing blue flowers. It is suited for planting in the lawn or in the Japanese garden.

Eranthemum. (*Acanthaceae*): Group of useful medium-sized and small shrubs, some of them pretty in foliage and some in flowers, thriving in shady and semi-shady situations. Propagated from cuttings.

E. pulchellum = *Daedalacanthus nervosus*. Referred to above, page 288.

E. hypocratifforme. 1 to 1½ metre. Bears bright brick red flowers with a maroon centre in erect clusters over all the shoots at one time, making a good show.

E. laxiflorum. 30 to 45 cms. Very pretty purple flowers, constantly borne. Makes a good pot plant.

Euphorbia. (*Euphorbiaceae*): Euphorbias are a genus of small shrubs, which are succulent in nature as the cactus and require similar treatment. *E. splendens* is a small shrubby succulent plant, ½ to 1 metre high, with prickly stem. Called by some 'Christ's Thorn'. It is perpetually in blossom with symmetrical trusses of scarlet flowers (bracts). The plant thrives well in situations fully exposed to sun. It is excellently suited for open rockeries. *E. Bojeri* is similar to the preceding species, bearing vermilion coloured bracts. **E. Jacquiniflora* thrives at medium elevations and is very attractive in bloom. All are raised by cuttings.

E. pulcherrima. See under Poinsettia.

***Franciscia bicolor** = *Brunfelsia uniflora* = *B. Hopeana*. (*Solanaceae*): A slow growing very handsome shrub, 1 to 1½ metres high, with light green leaves. Flowers are slightly fragrant and are produced in very great profusion in February-March when the plant has shed most of its leaves. The shrub is very ornamental in bloom being one mass of colour. The flowers change colour in 24 hours from violet blue to lavender which bleaches to white and hence the common name

'Yesterday, To-day and To-morrow' and the name of the species as 'bicolor'. The plant thrives better at medium elevations in light soil which has a lot of leaf-mould and sand incorporated into it. It is propagated from suckers, which the shrub throws out in large numbers when it is old.

Galphimia glauca. (Malpighiaceae) Canary Bush. See under Malpighia.

Gardenia. (Rubiaceae): There are several species of these choice tropical shrubs. They are generally deciduous and flower in great profusion when they are almost without leaves.

G. florida, Syn. *G. Jasminoides* (Hindi : Gandhraj) popularly known as the Cape Jasmine is a favourite delightful shrub with glossy foliage. It is a very slow grower, eventually attaining a height of about $1\frac{1}{2}$ metres. The flowers are large, double, creamy white, and they are produced freely in the rainy season. Propagated by cuttings and layers.

G. longistyla grows 1 to $1\frac{1}{2}$ metres in height and stands pruning well. It is a pretty quick grower with rough ovate leaves, and it throws out lots of suckers from the base, which should be removed. It blooms when it sheds its leaves, creamy white highly scented flowers being clustered in miniature bouquets. The flowers are bell-shaped with long projecting filaments.

G. lucida. A large shrub with rich foliage of bright shining oval leaves. 15 to 18 cms. long. Large white fragrant flowers, about 7 cms. in diameter, are borne during the hot and rainy seasons.

Goldfussia anisophylla. (Acanthaceae): A small cheerful close bush, 1 metre high, with small pretty dark leaves, bearing in profusion in the cold season, light blue, bell-shaped flowers. Requires shade. Native of Himalayas. Thrives at medium to high elevations. Makes a good pot plant. Propagated from cuttings.

Grislea tomentosa=*Woodfordia floribunda*. (Lythraceae): A jungle plant of India and Ceylon, 1 to 2 metres high, making a good show of its small tubular brick-red flowers borne along the weeping stems in an interesting way in February-March.

Guettarda speciosa. (Rubiaceae). Large shrub bearing long tubular fragrant white flowers throughout the year, rather thinly. Often grows into a small tree and is known as the "Pannir Maram or Tree" in Madras, where, it is very common. Propagated from seed.

Habrothamnus. See under Cestrum.

Hamelia patens. : (Rubiaceae). A large, slow growing spreading favourite shrub with dense attractive foliage of small green and greenish bronze leaves. It stands close clipping and rimming to any form. Trimmed shrubs grown alongside, walks or roads are of striking beauty. Hamelia makes a very good ornamental hedge. The flowers are small, pipe-like, orange-red in colour and do not contrast well with the foliage. Propagated from cuttings.

Hamiltonia : (Rubiaceae). *H. suaveolens* is a large stagging shrub, 1½ to 2 metres high, with broad lanceolate leaves, 7.5 to 15 cms. long, thriving in any garden soil with ordinary care. The flowers lavender-white and deliciously fragrant. Continuously in bloom for a long time, from October to February, in terminal corymbose heads. To keep the shrub neat and tidy, it should be heavily pruned back after flowering every year. Propagated by cuttings in August-September.

**H. azurea* has flowers of a deeper blue colour.

***Hibiscus.** (Malvaceae). (Canarese : 'Dasavala', Tamil : 'Sembaruthi', Hindi : 'Jaba'). Important genus of shrubs of great beauty including several distinct types and numerous hybrids. Only the *syriacus* type grows best on hill stations but it can be successfully grown in the plains too. The flowers are single or double, white or in shades of mauve, borne like Hollyhocks in the axils of leaves. The *mutabilis* type grows tall with coarse leaf and flowers, which are single or double, and in white, pink and rose shades borne in the cold months. The *rosa sinensis* type comprises a number of single or double flowering kinds of attractive colours as white, yellow, pink, orange, terra-cotta, cerise and deep red. The drooping forms of Hibiscus, as *H. schezopetalus* have long branchlets arching down and bearing ear-droplike flowers.

H. mutabilis *floro-pleno* (Canarese : 'Bettada Tavare') is

a large bush, 1 to 2 metres high, with large, double flowers, creamy-white on opening in the morning, changing to pale pink by mid-day and to deep rose by evening, borne throughout the year. If the shrub is pruned every year, it keeps a better appearance and produces more blooms. The pruning may be done safely in the month of April.

* *H. rosa sinensis* is a wide spreading large shrub, 1 to 2 metres high, with bright shining thick foliage. It is constantly in bloom with large brilliant rose-scarlet flowers which have pretty columns of pistil and stamens projecting from their centres. Very effective with its flowers from a distance. Useful for ornamental hedging.

There are several hybrids of the *rosa-sinensis* type with single and double flowers in varying shades of white, yellow, pink, rose, orange, mauve, scarlet and red. New varieties are raised from seed obtained by cross-pollination. The following are a few of the more attractive single flowering varieties:—

Albus: Cream shading to white with red centre.

Agnes: Huge flowers of cyclamen-pink, with deep pink centre.

Aurora borealis: Orange flowers.

Australian Single: Deep rose with maroon centre. Very large flowers.

Flaming sunset: Large, bright salmon orange with a red centre.

Glowing sunset: Deep glowing salmon orange.

Gold Mine: Large yellow with whitish centre.

Gold Glow: Large, very bright yellow.

Laxmi: Medium sized showy yellow.

Lip Stick: Bright red with dark centre.

Luna Shaw: Pale yellow flowers, large.

Meteor: Large, sulphur yellow, crimson with white halo around.

My Choice: Deep orange red splashed golden.

My Beauty: Very large pink with a prominent maroon centre.

Netaji: Flowers white with crimson centre.

Pagent: Pink magenta with dark red centre.

Pink Beauty: Large flowers of rose pink with white centre.

- Percy Lancaster : Single pale rose.
 Pride of Lanka : Vivid shade of salmon pink with a pale lemon halo.
 Rajendra Prasad : Very bright crimson scarlet.
 Snow White : White tinged mauve with reddish centre.
 Sulphurea : Large, sulphur yellow.
 Sunset : Large flowers, bronze with pale pink centre.
 Superb : Medium sized lovely pink flowers with very prominent red centre.

Superba : Large flowers of deep pink with white centre.

Syriacus : Medium sized lilac-blue.

Viceroy : Small deep rose-red flowers freely borne.

Waimeae : Single fragrant, snow white from Hawaii.

The following are some of the more attractive double varieties :—

Alipore Beauty : Deep rosy cerise. Grows like a tree, bearing hundreds of medium sized flowers.

Alex Silvia : Rose red small flowers.

Aurora : Flesh pink. Very large flowers.

Bhaskar : Very huge flowers of golden yellow turning to golden orange with a tinge of pink.

Brilliantissima : Large dark carmine flowers.

Centinary : Vermilion peach red.

Chitra : Marigold orange, lovely flower.

Daffodil : Very huge, true Daffodil yellow.

Dream : Large mauve flowers.

Gaekwar of Baroda : Light salmon pink with red centre.

Gulabi : Light pink.

Golden Spring : Apricot gold and pink flowers.

Golden Giant : Huge bright to lemon yellow with red centre.

Golden Gleam : Very huge attractive shade of butter cup yellow.

John Walker : Creamy white, fully double.

Juno : Cerise coloured huge flowers.

Lady Marjorie Erskine : Peach red big flowers.

Lord Linlithgow : Large reddish scarlet flowers.

Mahatma : Big double flowers, cadmium orange with red centre.

May Walker : Salmon cerise pink flowers, large.

Prince of Orange : Most elegant of the double Hibiscus. Very bright orange, large, huge flowers.

N. Roy : Bright orange yellow with tinge of pink and red.

Rex Travancorensis : Big flowers, golden yellow with maroon centre.

Rukmini : Very bright yellow, huge, large.

Ruby : Deep rose coloured large flowers.

Salmon Globe : Salmon orange. Very large flowers.

Syriacus double : There are two varieties bearing white double and lilac blue double flowers.

There are many noteworthy unnamed seedlings of the double and single varieties.

H. schizopetalus is an interesting ornamental shrub, 1½ to 2 metres high, with long slender arching branches bearing drooping orange-red or red variegated flowers, with their petals recurved and fringed.

Recently the most enchanting varieties of Hibiscus have been introduced by Dr. M. H. Mari Gowda, Director of Horticulture in Mysore, Bangalore, from Honolulu, Hawaii, in which country Hibiscus is the national flower. There are more than two thousand varieties in Hawaii. These have created a lot of interest in the Garden lovers and Horticulturists and the popularity of these lovely varieties is on the increase. They are most spectacular and exciting in colour, form and immense size, which varies from 12 to 25 cms. They possess contrasting and varied colours and the flowers are all singles, wide, flat, or saucer shaped, some with petals recurved, ruffled, and wavy. The leaves are thick, shining, dark green, roundish or ovate. These are absolutely free and continuous blooming and can be grown in pots or in the ground.

The following are the best of the varieties that are already being marketed by the nurserymen :

Battlion : Very unusual colour ; light biscuit grey colour with pink at centre. Measures 15 to 20 cms.

Beach Girl : Dutch vermilion with red throat, measures 15 to 20 cms.

Chester Frowe : Measures 12 to 15 cms. Petals deep red with distinct white and yellow patches and wavy.

Comet : Measures 15 cms., very bright ruby red to turky red.

Cromwell : Cream white with light pink centre and veins, 15 cms.

Debby Ann : Bright rose pink, 20 cms.

Exquisite : 20 to 25 cms. flowers of light lavender mauve with a white centre.

Florence Nightingale : Light mauve with pink centre, 20 to 25 cms.

Golden Belle : Silky golden yellow, 25 cms.

Grace Goo : Deep biscuit with buff with red centre, 15 cms.

Hawaii : Medium yellow to deep yellow, 15 to 20 cms.

Honi Honi : 15 cms. flowers of saffron yellow with medium red centre.

Hubba Hubba : 20 cms. Neyron rose with tips of petals amber yellow.

Hula Blue : Bright carmine to crimson red with white reverse. 15 cms.

Kanaka Nui : Dazzling coppery red to orange. 18 to 20 cms.

Lahiana : Self pink white, white shadings. 15 cms.

Leberacea : Light yellow with white centre. 18 cms.

Madame Florence : Saffron red with distinct yellow streaks. 15 cms.

Morley Theaker : Bright scarlet with white centre. 15 cms.

Niumalu : Flowers have deep honey red throat with very broad saturn red to orange petals. 20 cms.

Polly King. Verticle flowers of garnet brown to orange with rich poppy red corolla. Slightly semi double. 18 cms.

Roosevelt : Semi-double blooms of bright golden yellow with red centre.

Rosa Nabriga : Bright salmon-rose, 15 to 18 cms.

Ruffle : Petals ruffled, wavy and silky, bright Indian yellow.

Mai Mai : Flowers have light honey red throat and Rose madder. 15 to 20 cms.

Sebactani: Pure lavender—mauve, a very delicate colour, with lighter centre. 18 to 20 cms.

Splash: Petals are red, with irregular patches and streaks of creamy white as if smeared on the petals.

Suzan: Light yellow, with saffron tinge at edges and honey red centre. 12 to 18 cms.

Vasco: Lemon yellow with white centre. 18 cms.

White Pink Centre: Broad silky white with pink centre. 15 to 18 cms.

These varieties grow to a height of 1 to 2 metres and are best propagated by budding or side wedge grafting.

***Holmskioldia.** (*Verbenaceae*): Called the Parasol flower. *H. sanguinea* is a large shrub, 1 to 2 metres high, bearing in boundless profusion, peculiar orange-red flowers, nearly along the whole length of the shoots. The shrub is very beautiful while in bloom from February to May. For better flowering and to keep it compact and within bounds, it should be cut back after flowering. Thrives with little care and is propagated by cuttings or seeds. * *H. Sanguinea var acuminata* is another handsome species with pale apricot-coloured flowers. All the species can be trained as handsome standards. *H. coccinea* is a elegant species bearing bright crimson flowers. There is a very beautiful yellow variety also.

***Hydrangea.** (*Saxifragaceae*): Perennial small woody shrubs with handsome leaves, producing in the rainy season large compact trusses, which are 20 to 30 cms. in diameter, composed of bluish or pink or white flowers. In the plains, they seldom flower. At medium elevations, they are satisfactory, and are best on hill stations. At medium elevations they are grown as pot plants in 30 cms. pots. They require plenty of room for their roots which rapidly fill the pots; require a free supply of water, rich light soil, frequent administrations of liquid manure and a situation where they get only full morning sun. They should be pruned back after flowering to $2\frac{1}{2}$ to 5 cms. from the base, as blooms are only produced on new shoots. For large heads of bloom, if too many shoots come up, only three are retained. Suckers should be removed and utilised for making new plants. The pink flowered variety may be induced to bear blue flowers by application once a

week of water in which iron nails are soaked or better still about 5 grains of sulphate of iron is dissolved. Also propagated from cuttings. *H. Hortensia* is the commonest species grown and one which can be grown with success at medium elevations. *H. paniculata* is a handsome species which thrives only on the hill stations.

Iochoroma tubulosa. (*Solanaceae*): Called the Purple Cestrum. Large pretty shrub with attractive clusters of blue flowers. Requires the same treatment as the Cestrum. In *var Mrs. Seymour*, the flowers are rosy-purple and it *var coccinea*, they are pale rosy scarlet. Easily propagated by cuttings or layers.

* **Ixora.** (*Rubiaceae*): (Hindi: Rangon or Rukmini). A genus consisting of several species of beautiful and useful shrubs or small trees. Of late, several excellent dwarf hybrids have been introduced, which are loaded with terminal corymbs of flowers above the beautiful evergreen foliage, bearing a close resemblance to Hydrangeas. The flowers are packed in large, dense, terminal trusses (corymbs) and they remain fresh for several weeks. Ixoras are available in yellow and white, pink, yellow, orange and orange-scarlet colours. They flower best in the hot season and during the rains and in fact throughout the year. The shrubs can with advantage be pruned back every time after the flush of blooms is over. With slight shade and adequate supply of water, they grow best in sandy loam though they are not very particular as to soil. Several species may be grown in tubs or large pots with very good results. Propagated easily by layering or cuttings with difficulty. The following are noteworthy species:—

* *I. Griffithsii*: A bush, 1 to 1½ metres high, bearing very pretty bright orange flowers in large trusses measuring 15 to 25 cms. across. They are produced so freely that on a bush about 60 cms. high, one can depend upon at least twenty heads. The bunches of flowers last for a good length of time, adorning the plant for nearly a month.

* *I. macrothyrsa* = *I. Duffii* grows about 1½ metres high and is very pretty with its large leaves about 25 cms. long and large heads of a bright scarlet, which are very lasting. Likes a sheltered situation.

I. coccinea is of a bushy habit of growth, reaching a height of about $1\frac{1}{2}$ metres. When in bloom, from the end of the rainy season till the hot weather is much advanced, it is quite an enviable object with its bright red flowers which are produced very freely. *I. coccinea magnifica* is a greatly improved variety with brilliant red flowers in large trusses.

I. singaporensis bears very large showy huge terra-cotta coloured heads throughout the year.

I. parviflora is a large shrub or a small tree bearing pure white flowers almost throughout the year.

I. stricta is a dwarf kind which has small leaves and which is very floriferous.

I. flava is of a scandent habit and bears pure yellow blooms.

Among other attractive kinds of merit are *Prince of Orange* and *Aurora* with orange-coloured flowers, *venusta* with butter yellow flowers, *undulata* and *barbata* with white flowers and *rosea* with pink flowers. *I. brunescens* has a very huge head of white flowers.

Jacobinia. (*Acanthaceae*): Group of shrubs allied to *Justicias* and including them. See under *Justicia*.

Jacquinia ruscifolia. (*Mrysinaceae*): A large shrub, 1 to 2 metres high, of dense habit, with sharp pointed, narrow, lance-shaped leaves, bearing pretty small star-like bright orange flowers in great profusion. The shrub is not handsome to look at when not in bloom. To improve its appearance, it should be trimmed every year. Propagated by seed.

Jasminum. (*Oleaceae*): A much valued genus of flowering shrubs and climbers, well known for the rich fragrance of their flowers. They are well represented in all Hindu gardens, where they are grown for flowers for puja and for the women-folk who love them, and use them for head adornment. There are several species producing double or single, white or yellow flowers of sweet fragrance in great abundance. Several species are coarse looking, except when in bloom. Some, as *J. grandiflorum* have ornamental foliage. All the species thrive in rich loamy soil. Their branches have to be cut back to half their length or more after a month after flowering. At that time manure has to be dug in and the

plants copiously watered, when new shoots start out vigorously. Treated this way, the shrubs bloom twice a year. Jasmines can be forced to bloom by withholding water from them till they shed all their leaves and then supplying them with rich manure and copiously watering them regularly to induce side growths. All the species of *Jasminum* are easily propagated by cuttings in the rainy season. Branches or shoots are made into the form of loops, and inserted in such a way that one half of the loop is above the soil. The nomenclature of Jasmines is very much confused; but even if one were not to know the names of the species, it would be easy to make a selection of choice plants from any nursery.

* *Jasminum Sambac*: (Arabian Jasmine). (Vernacular: 'Bela', 'Mallipoo'). The most popular species. Dwarf spreading bushy shrubs, $\frac{1}{2}$ to 1 metre high, with attractive glabrous leaves and producing in the hot season, attractive, white, sweet scented flowers in great profusion. There are several varieties but these are well known types (1) those bearing single flowers, (2) those bearing semi-double flowers, (3) those bearing small double flowers (Vern. 'Racael', 'Gundu mallipoo',) and (4) those bearing fully double large flowers (Vern. 'Mogra', 'Yelusuttu malikai'). The last kind is called the Grand Duke of Tuscany.

* *J. grandiflorum*: (Vern. "Jatee, Jati-Jai, Kund, Jaji"). A large twining ornamental shrub with long slender pendulous branches with very pretty dark green shining foliage consisting of about eleven leaflets, which are less than $2\frac{1}{2}$ cms. in length. The flowers are produced freely in February-March. They are pure white above and tinged purple underneath, are very highly scented, circular and about 4 cms. in expansion.

J. angustifolium, *J. azoricum*, *J. candidum*, *J. ligustrifolium*, etc., are a few among the well known species.

Of the yellow flowered Jasmines, there are two varieties:—one is more or less shrubby, grows to a height of about $1\frac{1}{4}$ metre has attractive polished small leaves and bears scentless bright flowers. The other has a straggling and climbing habit and bears double very slightly scented flowers.

Jatropha multifida. (*Euphorbiacea*): Called the Coral Plant. A large evergreen shrub, $1\frac{1}{2}$ to $2\frac{1}{2}$ metres high, with

handsome large palmately cut leaves. Bunches of small coral-red flowers are borne at the ends of branches in summer. The plant remains attractive only if kept bushy by cutting back the branches every year after the flowers are over. Easily propagated by cuttings and by seed.

J. panduraefolia : A small shrub, 1 metre high with fiddle shaped leaves with two teeth at either side of the base and bright crimson flowers. There is a pink flowered variety also. Makes a better plant and bears more flowers, if pruned back in the cold season.

J. podagarica : A succulent shrub, about $\frac{1}{2}$ metre high, with stem thickened at the base to an oval club, dichotomously branched, grey skinned. The leaves are at the ends of the shoots in a head of 6-8 together, are long stalked, three-lobed, large, 15 to 18 cms. long and as wide. Flowers, brilliant scarlet. An interesting plant suitable for pot culture. Should be sparingly watered in winter, when the leaves fall off.

Justicia. (*Acanthaceae*) : Most of the garden shrubs known as Justicias are Jacobinas. Other plants allied to these are Barlerias. Eranthemums etc. Justicias are medium-sized shrubs 90 to 120 cms. high, with large leaves and clustered heads (dense panicles or thyrses) of red or yellow flowers. They are very showy in bloom, for several weeks. As the flowers are borne terminally on young branches or shoots, the shrubs should be cut back after flowering. They thrive in semi-shady situations and are suitable for beds in shade gardens and for shrubbery borders. They can also be cultivated in 30 cms. pots. Easily propagated by cuttings.

* *J. carnea*. (*Syn. Cyrtanthera magnifica*) has pretty long, sometimes over 30 cms. long and broad, lanceolate to ovate-lanceolate or oval-oblong leaves and bears dense terminal large clustered erect heads of long carmine flowers with gracefully recurving corolla. Requires rich soil and plenty of water during growth. A really showy species, flowering almost throughout the year.

J. coccinea bears crimson-scarlet blooms, $\frac{1}{2}$ to 1 metre high.

* *J. cyrsostephana* = (*Syn. J. aurantiaca*) : Is very showy in bloom with its bright golden yellow flowers which are nearly

6 cms. long and are clustered in dense erect terminal corymbs which are set off to advantage by red-ribbed leaves, which are 12 to 15 cms. long. A winter flowering species 1 metre high.

* **Kopsia fruticosa.** (*Apocynaceae*): Also known as *Cerbera fruticosa*. An evergreen light scandent shrub, 1 to 1½ metres high, with light green leaves bearing in profusion throughout the year, pale pink flowers with a red centre. The flowers resemble single jasmine flowers in form. It thrives in a partially shaded situation in any good soil, without much care. Propagated by cuttings and by layering, and sometimes by seed.

Lagerstroemia. (*Lythraceae*): A genus of pretty trees and shrubs. The trees have been considered at page 247. The shrubs are called Crepe Myrtles. They are tall, deciduous shrubs 1½ to 2½ metres high, with small leaves. Easily raised from cuttings or by division of the suckers. Easily grown in any garden soil without care. Pretty in bloom with their soft, fringed showy flowers arranged in long erect sprays, from May to August. The colours of the several varieties are pink, rose, mauve, or pure white. Valuable in the shrubbery or for screen planting or even for hedging. As blooms are produced on shoots of the current year's growth the shrubs should be pruned when they are resting in January-February. *L. indica purpurea* bears mauve-coloured flowers. *L. indica alba* bears white flowers. *L. indica rosea* bears rose-coloured flowers. *L. The Bride* bears pink flowers.

L. Lancasterii has larger leaves of *L. Flos reginae* type and bears large violet-coloured beautiful flowers in large sprays.

Lantana. (*Verbenaceae*): A group of common but beautiful large bushes with spiny stem, rapid and vigorous in growth, and requiring to be cut down or trimmed to keep them within limits. They are well adapted for hedging or fencing. Tall standards with large trimmed globular heads are attractive, planted in rows alongside paths or roads at 2 to 3 metres apart. The garden varieties are less vigorous in growth than the kinds growing wild and they are suitable for planting on lawn as single specimens or in groups in large beds. Easily raised from seeds or by cuttings.

The best kinds for cultivation are :—

* *L. nivea* with pure flowers is strikingly attractive. *L. camara* is orange-red in colour. Some small bush types which are very attractive are :— “ Snow Queen ” (white flowers) “ Drap d’or ” and “ Golden Gem ” (yellow flowers ;) “ Grenadier ” and “ Red Cap ” (red flowers) ; “ Orangeman ” (orange flowers) ; “ Lilac Queen ” (lilac flowers) ; “ Mauve Queen ” (mauve flowers).

* *L. sellowiana* is pink-mauve in colour, low growing, trailing in habit, and best suited for rockery or hanging baskets, or rambling over low wall.

* *L. depressa* is a semi-trailing pretty dwarf yellow flowered kind, suited for pot culture, rockery, or border.

Lawsonia alba. (*Lythraceae*) : (Canarese : ‘ Goranti ’ ; Tamil : ‘ Maruthani ’ ; Hindi : ‘ Mehndi ’) : Popularly known as Henna or the Tree Mignonette. A large shrub easily becoming unattractive if not pruned back every year. Grows to about $2\frac{1}{2}$ metres has small myrtle-like leaves and sticky branches. The flowers are creamy-white in colour, very highly and sweetly scented, and borne profusely in large panicles. Largely used for hedging, as it thrives with little care and is much branched. It is the favourite of Hindu gardens ; its leaves are crushed and applied to the nails on the fingers and toes for colouring them deep red. The flowers are used for puja. At least for the perfume of the flowers no garden should be without this shrub. Propagated by seeds (the flowers are followed by bunches of berries), or by cuttings.

L. rubra bears panicles of light rose-coloured flowers.

Ligustrum. (*Oleaceae*) : Ligustrums are the Privets. *L. japonicum* is the best species. A large, evergreen, robust growing shrub, about 2-metres high, with large coriaceous leaves and gracefully-drooping branches. Bears abundantly, terminal, loose panicles of slightly scented, yellowish white flowers. Easily raised by cuttings. Suited best for medium elevations. *L. ovalifolium* is also a popular plant useful for hedging, as it may be clipped close to any height and shape. *L. robustum* is still another handsome species.



ALOE VARIEGATA



ALOE HANBURYANUM



BEGONIA SEMPERFLORENS



GERANIUM

Magnolia. (*Magnoliaceae*) : Magnolias are a group of small trees, and shrubs, which are very popular on account of the fragrance of their flowers. They are suited for medium to high elevations. At low elevations, they remain as shrubs and do not grow up into trees.

* *M. grandiflora* is the best species. See page 248.

M. pumila is an attractive species not growing more than 1 metre high and bearing fragrant white flowers. *M. fuscata* and *M. mutabilis* are other handsome species. All are propagated by seeds or by gootee-layering.

Malpighia. (*Malpighiaceae*) : * *M. coccigera* is a small shrub, $\frac{1}{2}$ to 1 metre high, thickly beset with small, spiny, shining, holly-like leaves and bearing in profusion, small pinkish flowers from August to November or at other times. The flowers are followed by cherry-like berries of the size of peas. The shrub is highly ornamental, of slow growth, and thrives in any garden soil, with occasional watering in summer. It is useful as a hedging plant for paths and borders or as specimen plant on a lawn. Propagated by cuttings or seeds.

M. glauca, called the "Canary Bush" grows upright, 1 metre high, with opposite, entire, elliptical small leaves. Bears in great profusion terminal racemes of bright yellow, slightly scented flowers. Has a very long blooming period from July to October. It flowers at other times too, by timing its pruning. The shrub is very valuable in the shrubbery, for planting in groups in large beds and is suitable for making an ornamental hedge, on account of its tidy habit. Propagated by seeds or cuttings. Also known as *Galphimia nitida* and *G. glauca*.

M. glabra is the Barbados Cherry, a slow growing shrub, about $1\frac{1}{2}$ metres high, from the West Indies with upright slender branches and glossy leaves. Rose-pink small flowers are produced in autumn and winter and they are followed by beautiful red cherry-like acid fruits of a fine flavour and used for jams and preserves. Cultivated for its fruits on a large scale at Gwalior.

Memecylon umbellatum. (*Melastomaceae*) : Grows $1\frac{1}{2}$ to 2 metres. Flowers are small, deep blue in colour, and crowded in clusters along the stems. Showy in bloom. Native of Ceylon and India.

Meyenia erecta. (*Acanthaceae*): Also called *Thunbergia erecta*. An erect bushy shrub, 1 metre high, with deciduous pretty small dark green leaves, bearing large, Gloxinia-like, funnel-shaped, open-mouthed, purple-blue flowers with yellow throat and tube. Very handsome when in full bloom in February, with its flowers peeping out through the foliage. A very hardy shrub, very desirable for a mixed border. Suited for ornamental hedging, as it stands trimming well. Easily propagated by cuttings. A native of West Africa. *M. erecta* variety *alba* is a dwarf shrub, about $\frac{1}{2}$ metre high, with pretty white tubular flowers. There is also a lavender-coloured variety.

* **Montanoa bipinnatifida.** (*Compositae*): The Tree Daisy or Christmas Daisy. A tall large comparatively short lived deciduous shrub, 2 to $2\frac{1}{2}$ metres high, with large broad leaves. It bears white, daisy-like flowers in large bunches, in very great profusion in the cold season, from December to February. The shrub is very handsome while in bloom. It should be cut back after flowering. Propagated by cuttings. Thrives at medium elevations. A dry sheltered situation protected from hot sun is best.

* **Murraya exotica.** (*Rutaceae*): (Canarese: 'Angarakana gida'; Bengali: 'Kamini'). Known popularly as the China Box. The shrub is evergreen, growing up to $2\frac{1}{2}$ metres in height. The foliage is very pleasing, being composed of deep glossy green pinnate leaves. The shrub is very handsome when in blossom in the rainy season, bearing large clusters of white flowers, which scent the air with their sweet fragrance. It stands trimming well and can be trained to any shape. Propagated by seeds or cuttings with bottom heat or by layers. No garden should be without this shrub.

Mussaenda. (*Rubiaceae*): A group of very ornamental shrubs, which are medium-sized and grow to about $1\frac{1}{2}$ metres. The leaves are evergreen and the beauty of the shrubs is due to the coloured calyx lobes of the flowers. In each flower or in a few flowers in each corymb, calyx lobe is much enlarged and brightly coloured. Both in the hot and the rainy season, the bracteal leaves makes the shrubs objects of beauty. They should be planted in deep soil and watered frequently. Propagated by layering or cuttings.

* *M. erythrophylla* is the most showy species with its large Poinsettia-like crimson bracts. In the plains, it is more difficult to grow than other species. Should be sheltered from western sun and well drained.

M. lutea grows 1 metre high, has pretty green leaves and bears small bright yellow flowers in terminal clusters. The bractial calyx lobe is coloured cream or light yellow.

M. frondosa bears terminal bunches of flowers of a bright gold colour. The enlarged sepal is large and white and spatula-shaped. The latter two species are, both of them, very hardy and thrive without much care.

M. corymbosa has like *frondosa* white sepals. Called "Dhoby Bush"; "Handkerchief Plant".

M. Phylipica is a new handsome variety.

Myrtus communis. (*Myrtaceae*): (Hindi: 'Belatee mehndee'). Is the famous Myrtle. A familiar shrub, 1½ to 2 metres high, with small polished, green leaves, which are scented and used largely with flowers in garlands and bouquets. It bears pretty, small, scented flowers in the month of March-April, which are followed by blue-black berries. It thrives well at medium elevations. To keep it in good condition, it should be planted in deep soil and watered frequently. Propagated by seeds or layering or by cuttings.

* **Nerium.** (*Apocynaceae*): (Canarese: 'Ganigalu'; Tamil: 'Arali'; Hindi: 'Kunel or Karubi'; Telugu: 'Ganneru'): The Oleanders are some of the most delightful of fine flowering shrubs, which no Indian garden is without. They are graceful, large, spreading bushes, 1½ to 2 metres high, with a number of cane-like stems starting from the ground, bearing narrow ever-green, lanceolate leaves. The flowers are produced very freely throughout the year in very great profusion in large terminal clusters. There are several varieties, with single and double flowers, of pure white, cream, pink, rose, salmon and crimson colours. They have a delicious fragrance, and are very much valued for puja purposes, and for making garlands. These shrubs grow to perfection in sunny situation, in sandy or stony soils but not in stiff soils. Regular watering keeps them always cheerful and full of flowers. After flowering, about April, the shoots if cut back to a third of their length, produce

new shoots rapidly, from which more flowers are obtained. By doing so the plants are maintained bushy and handsome. At the time of pruning, manure should be dug into the soil and the shrubs watered satisfactorily to promote fresh growths. Propagated by cuttings or by layers. The juice of the stem and the roots is poisonous. The bark is sometimes used for ring worms in a pasty form.

Nyctanthes arbor-tristis. (*Oleaceae*): (Sanskrit, Canarese and Tamil: 'Parijata'). A hardy large shrub or small tree with rough hairy leaves. It is very popular in Hindu gardens where it is grown for the sweet scent of its flowers, which are much valued for puja purposes. Unless the long woody branches are cut back every year after flowering, the shrub easily becomes ugly. The flowers are very pretty having a white corolla and an orange-red tube and centre, are produced in plenty in the months of September, October and November, spreading their strong scent to a long distance. The flowers open in the night and are cast off in the morning, making a carpet of flowers under the shrub. Easily propagated from seed or by cuttings in the rains. Grows with little care in any garden soil and blooms well in semi-shady situations.

Ochna squarrosa. (*Ochnaceae*): (Hindi: 'Ramdhan Champa'). A deciduous shrub, 1 to 2 metres high, bearing large, bright, yellow, fragrant flowers early in the hot weather on bare stems, followed by maroon-coloured berries, ornamented by scarlet calyces. It is very handsome for several weeks being full of flowers. The new leaves are ornamental being tinged with red. Propagated by seeds or cuttings.

**O. Kirkii* is a smaller shrub. Flowers are yellow and the berries scarlet.

Olea fragrans. (*Oleaceae*): A slow growing shrub which delights in semi-shade and blooms several times a year, producing sweet scented small creamy white flowers. Propagated by layering.

* **Pentas.** (*Rubiaceae*): *Pentas carnea* is a small herbaceous shrub, about $\frac{1}{2}$ metre high, bearing very pretty Ixora-like trusses of flowers of pink, lilac, scarlet or white colours almost throughout the year. The pink coloured variety is the commonest. Thrives with comparatively little care in any

garden soil. Useful as an ornamental hedging plant. Attractive, grown in pots too. Thrives best in semi-shade. Propagated by seeds or cuttings.

P. lanceolata bears pale purple flowers and has larger leaves than the preceding species. *P. Kermesiana* bears red flowers. There is a variety bearing carmine-rose flowers.

Petrea aborea. (*Verbenacere*): Called the brush purple wreath. Flowers purple blue in several flushes on erect-plant of $1\frac{1}{2}$ to 2 metres.

Philadelphus. (*Saxifragaceae*): (Mock-orange). A family of deciduous flowering shrubs of great beauty while in bloom. Suited for medium to high elevations only. They can be grown in the ground or in pots. As the blooms are produced on old shoots, the shrubs should be pruned soon after flowering. They prefer a semi-shady to a sunny situation.

P. coronaria is a hardy ornamental shrub, about 1 to 2 metres in height, bearing creamy white single or double flowers. Blooms in February-April. Propagated by cuttings or suckers or layers.

P. Lemoinei and *P. pubescens* are two other valuable species.

Phlogacanthus thrysiflorus. (*Acanthaceae*): A winter flowering shrub, 1 to $1\frac{1}{2}$ metres high, with handsome deep green laurel-like leaves, bearing in profusion long spikes of large dull red flowers. Useful in the shrubbery. Propagated by cuttings in the rainy season.

* **Plumbago.** (*Plumbaginaceae*): (Canarese: 'Chitram-ula': Hindi: 'Chitra'). The Plumbagos or the 'Leadworts' are useful, flowering, evergreen shrubs of great beauty. The *P. capensis* is a small bushy shrub, 1 metre high, with small, light green, lanceolate leaves. It bears almost throughout the year a profusion of umbel-like clusters of pale azure-blue, very pleasing flowers. It is a very common ornamental plant in almost all gardens, very serviceable as an edging or an ornamental hedging plant or in the border of the shrubbery along with other undershrubs. It can be trimmed to shape and the edging composed of Plumbago can be kept neat and tidy at a height of even 22.5 cms. Propagated easily by suckers and by cuttings. *P. alba* is a variety of the above species with

prettier, pure white flowers. But it is not as hardy as the blue variety, at low elevations. * *P. rosea* (Hindi Lal chitra) is a small undershrub, about $\frac{1}{2}$ metre high with leaves much larger than in the above species. It is very pretty in the cold season with rosy-scarlet flowers produced in long terminal spikes. Once planted, it requires very little care, suckers bearing the flowers coming out year after year. As new suckers are formed from the roots, the old growths are cut back to the ground level after flowers are over and the plant liberally manured and watered. Propagated by division of offsets or by small cuttings with a heel in the rainy season. * *P. rosea coccinea* is a more brilliant variety of the above with larger and brighter coloured flowers; but it thrives only 1,000 metres above sea level.

Plumeria. See page 252.

* **Poinsettia.** (*Euphorbiaceae*): Named after Poinsette who discovered the plant in Mexico in 1828. Also styled *Euphorbia pulcherrima*, Large, rapid growing shrubs, $1\frac{1}{2}$ to $2\frac{1}{2}$ metre high with large green leaves, and bearing small inconspicuous flowers, which are surrounded by large bunches (whorls) of elliptical, brightly coloured, bracteal leaves, in the cold season. The bracteal leaves constitute the ornamental feature of the shrubs, which are very handsome grown in groups in the shrubbery or in large beds. In pots, Poinsettias make excellent Christmas plants. They may be grown in bush form in large pots or they can be grown in small 20 cms. pots being prepared fresh from cuttings inserted in sand in sand in the month of August to September. They strike root in 5-6 weeks and are ready for potting for display during Xmas. The soil used, should be light and porous and the roots should not be disturbed when the cuttings are potted or there will be a setback. The commonest species grown is *P. pulcherrima* with crimson bracts. *P. plenissima* with double bracts is the one generally grown. There are two other varieties *P. albida* cream-yellow and *P. Rose Queen* with rose-coloured bracts. After flowering, the shrubs should be cut back severely, 15 to 30 cms. from the surface of the ground, to make compact and large shrubs for the next season. The shrubs do not like water-logging. They require full sunshine.

* **Polymnia grandis.** (*Compositae*) : Very much like *Montanoa* but with large leaves and blooms.

Portlandia grandiflora. (*Rubiaceae*) : A very attractive shrub, 1 metre high, with very handsome rich glossy green leaves bearing frequently large white trumpet shaped, white Lily like flowers, 12 cms. long. Propagated by layering or by cuttings in the rainy season.

Punica granatum. (*Myrtaceae*) : (Canarese : 'Dalambari' ; Tamil : 'Madalam' ; Hindi : 'Anar'). There are two varieties *albopleno* and of *florapleno*, of the Flowering Pomegranate, bearing large double Balsam-like flowers of white or brilliant scarlet colour. They are hardy bushes, which are easily propagated from cuttings, and grow on any soil without much care. For neat bushy appearance, they require to be cut down once in two years. Useful for hedging. Do not flower so freely in the plains as at medium elevations.

A dwarf variety *nana* $\frac{1}{2}$ to $\frac{3}{4}$ metre with rich scarlet flowers setting into miniature attractive coloured pomegranates borne plentifully and beautifying the plant, is excellently suited for pot culture. Fruits are edible too.

* **Quassia amara.** (*Simarubaceae*) : A large pretty shrub, worthy of a place in the garden, with its handsome, alternate, unequally pinnate leaves, having seven narrow leaflets and crimson tinged wings on the leaf-stalks. It bears bright scarlet, tubular flowers, which are 4 cms. in length, in terminal clusters similar to *Salvia splendens*. Suitable for planting in the lawn. Propagated by seeds, cuttings, or layers. The blooming period is usually from July to September. Its bitter bark is used in medicine.

* **Randia macrantha.** (*Rubiaceae*) : Pretty shrub, 1 to 2 metres high, bearing remarkable showy long tubular white flowers in great profusion. Propagated by Layering.

Ravenia spectabilis = *Lemonia spectabilis* (*Rutaceae*) : A shrub, 1 metre high, with dark evergreen tri-foliate leaves ; very showy when in bloom, from July to November, with bright rosy five-lobed flowers of the size of a four-anna piece. The shrub thrives in moist districts (or in other places with regular supplies of water to keep its foliage rich verdant green) in semi-shady situations. Propagated by seeds, which should

be sown fresh, or by cuttings, or by layers. There is a variety with pink flowers.

Rivina humilis. (*Phytolaccaceae*). A herbaceous perennial, weedy shrub, $\frac{1}{2}$ to $\frac{3}{4}$ metre high, with small leaves and bearing racemes of inconspicuous white flowers, which are succeeded by clusters of bright red small berries adorning the plant. The plant is well suited for rockeries and grows wild with little care and self-sows itself. Propagated by seeds or cuttings.

***Rondeletia speciosa.** (*Rubiaceae*). A pretty shrub, 1 metre high, bearing scarlet Ixora-like flowers, with orange centre almost throughout the year, but particularly during the hot weather and rains. Propagated by layering or by terminal cuttings.

Ruellia. (*Acanthaceae*). Called "Christmas Pride". A genus of herbs and small herbaceous shrubs. The flowers are showy. Propagated by cuttings. *R. Baikiei* is an under-shrub producing crimson-red flowers which are trumpet-shaped and gathered in racemes, from September to April. *R. tuberosa* bears handsome purplish blue flowers. *R. macrantha* is a very attractive species from Brazil. It is very floriferous, the plant being laden with blossoms for many months. The flowers are rosy purple in colour, about $2\frac{1}{2}$ cms. in length, and tubular. It is a good conservatory plant thriving well in semi-shade; it is suited for culture in hanging baskets. To have specimens, full of shoots and leaves, the plants should be pinched back every now and then. The leaves are very handsome, the upper side being purplish green with silvery veins and the under side purple. The plants should be well fed with liquid manure once a week and after flowering, they may be cut back and potted into larger pots. Propagated by cuttings. A really handsome species, very useful for culture in conservatories and hanging baskets. *R. formosa*, *R. macrophylla* and *R. rosea* are some other attractive species.

***Russelia juncea.** (*Scrophulariaceae*). Weeping Mary. Also called the Coral Plant on account of the bright coral-red flowers, which are tubular, about 4 cms. long, and borne in plenty along the greater length of the pendulous branches, which are grass like. The plant is bushy with its green grass-like branches and pseudo leaves. Grows to about $\frac{3}{4}$ metre.

Useful for ornamental hedging or for hanging basket. Propagated by cuttings or by division.

* *R. floribunda* is very pretty while in bloom with its scarlet flowers during the early hot season. It has a stiff habit unlike the preceding species. Grows to about 1 metre.

Solanum Rondelettii. (*Solanaceae*). Pretty with its small leaves and deep violet blue scented flowers about the size of an eight anna coin. Produced in profusion. Grows 1 to 1½ metre but is best when cut back and kept bushy. Propagated by cuttings or from seeds.

Sophora. (*Leguminosae*). Ornamental shrubs of medium height, which are suitable for planting in the border. At medium elevations, *S. violacea* thrives well, growing to about ¾ metre and bearing large racemes of pretty violet-coloured flowers. *S. tomentosa* bears large clusters of yellow or orange, bright flowers of great beauty.

Stachytarpheta. (*Verbenaceae*): (Canarese: 'Uttirani'). Hardy flowering shrubs, which are drought-resisting, and bear throughout the year Verbena-like, rose, red, or purple flowers on tall spikes. The shrubs are useful in the border and they are easily raised by seeds or by cuttings. *S. rosea* grows about 1 metre high, with spikes about 40 cms. long, composed of rose-red flowers, which have a pink eye. Nearly always in bloom. *S. mutabilis* bears spikes of pink flowers. *S. indica* bears deep blue flowers.

* **Streptosolen.** (*Solanaceae*): *Streptosolen Jamesoni* (*Syn. Browallia Jamesoni*) is an evergreen choice shrub, which thrives well at medium to high elevations. In the plains, the plant grows but does not flower freely. Attains a height of about 1 metre and bears abundant large terminal clusters of bright orange flowers of great beauty, bending the slender pendulous branches with the weight of the blooms. It may be trained as a standard, the central stem being supported by a stake. It makes a bold display in the mixed border and it can be grown in large pots too. Propagated by cuttings of soft new shoots.

Strobilanthes. (*Acanthaceae*): Evergreen dwarf shrubs with herbaceous stem. They grow with little care, some being cultivated for their flowers and some for their handsome

foliage with mettalic lustre. They are all effective grown in clumps. The flowers are capitate or in spikes. Propagated by seeds or cuttings.

S. scaber: Pretty small shrub. Bears in March thimble-formed yellow flowers in great profusion in clusters.

S. pulcherrima is showy with bright pink and violet flowers. 1 to 1½ metres high.

S. coloratus bears purple flowers.

* **Tabernaemontana coronaria.** (*Apocynaceae*): (Canarese: 'Nandi battalu'; Tamil: 'Nandiya vattai'; Hindi: 'Chandni'). A small evergreen shrub, 1 to 1½ metres high, with handsome foliage of glossy bright green leaves. The flowers are single or double and very attractive and are freely produced; they are snow-white in colour and sweetly fragrant. The plant blooms throughout the year. By regular watering, the shrub keeps neat and tidy. It is hardy and thrives in rich soil in sunny situations, and is a great favourite in Indian gardens. Propagated by layers or by cuttings. *T. coronaria* variety *florepleno* (the double flowered kind) is a very attractive shrub for planting in the lawn or for placing in the border. There are species with leaves, variegated creamy yellow and light green. *T. Wallichii* is the single white variety.

Tamarix. (*Tamariaceae*): Casuarina-like leafless large shrubs or small trees, fond of dry, salty areas or sea coast. Make good windbelts. Pleasing when in bloom with pendulous spikes of small flowers.

T. gallica var. *indica* (Ver. 'Jau') bears pink flowers; *T. articulata* bears pale mauve flowers. Grows eventually into a tree.

Tecoma. (*Bignoniaceae*): Genus of showy, evergreen shrubs, bearing terminal clusters of brightly coloured, tubular (campanulate), large, pretty flowers. Easily propagated by cuttings or from seed. The climbers, *T. jasminoides* and *T. camprisi grandiflora* are considered in Chapter XX. The following are the noteworthy species:—

T. stans is a large shrub, very commonly planted in all gardens for screening high compound walls or in the shrubbery in front of large trees or for hedging. The foliage is

handsome consisting of graceful pinnate leaves. Should be maintained bushy by cutting back the branches every year. The shrub is a very hardy quick grower attaining a height of about $2\frac{1}{2}$ metres. The flowers are golden yellow in colour, large, funnel-shaped and wide expanded, and clustered in terminal bunches.

T. chrysantha is similar to the above but has prettier deep serrated foliage and bears larger bunches of flowers.

* *T. Smithii* is a hybrid introduced from Australia and it is a smaller shrub than the preceding two species. Large panicles of orange-yellow flowers with bronzy markings on the outside are freely produced. Easily raised from seed, from which it comes out true.

* *T. capensis*: Cape Honeysuckle. A half climbing shrub, 1 to $1\frac{1}{2}$ metres high, with scandent branches and pinnate leaves bearing terminal racemes of tubular, Honeysuckle-like flowers of a bright orange-scarlet colour. It is easily grown, blooms throughout the year, and is very popular. Suited for planting on lawn trimmed to shape, for planting in large beds in groups, for forming an ornamental hedge, for training as standards.

T. campsis radicans is a more sprawling form of the above species.

T. gaudichandi: A tall shrub of 4 metres with a large number of golden yellow flowers, most suited for back row of shrubbery.

Tephrosia. (*Leguminosae*): *T. macrantha* is a tall shrub, 2 to $2\frac{1}{2}$ metres high, with pinnate leaves, having 10 to 12 pairs of leaflets. The flowers are purplish white in colour, and resemble those of Sweet Peas and are borne in large terminal panicles which are often 2.5 cms. long. A truly showy plant.

* *T. grandiflora* = *T. purpurea* is a much smaller shrub, about $\frac{3}{4}$ metre high, with purplish red flowers. *T. candida* is known in Tea gardens as Boga Medeloa bearing white pea-shaped flowers, beautiful in bloom in September-October. It is a popular green manuring plant.

Thespesia macrophylla. (*Malvaceae*): Also called *Thespesia Lampas*. A large shrub, 1-2 metres high. Flowers are large, bright yellow in colour with crimson spot in the centre

resembling the 'Bende' or 'Okra' flowers. The stems should be cut back in February to 30 cms. from the ground level for a bushy handsome shrub.

Thevetia. (*Apocynaceae*): Handsome large shrubs, sometimes growing into small trees, if allowed to do so. They attain a height of 2 to 3 metres and possess a light, bright, glossy green, handsome foliage consisting of linear leaves, which are 7 to 15 cms. long resembling those of Oleander to which they are closely allied. The flowers are funnel-shaped, large, and borne in terminal cymes. They are white, yellow, or light orange-red in colour. *T. nereifolia* the commonest kind grown, is the yellow flowering variety, and is called 'Yellow Oleander'. It forms a pleasing, bushy, large, ever-green shrub, which is suited best for screen planting. Pruned back every second year, it remains bushy and attractive with its new bright shoots. Propagated by cuttings or by seeds, which are poisonous. The seeds are crushed and boiled in water and the latter used as an insecticide.

Thunbergia. See under Meyenia.

Tithonia tagetaeflora = *T. diversifolia* (*Compositae*). Also known as the Perennial Sun Flower. A spreading, coarse looking shrub which is covered with large yellow flowers like single sun-flowers, from November to January. Thrives best in sunny situations. Propagated from seed or cuttings.

Turnera. (*Turneraceae*). *T. ulmifolia* is a pretty flowering shrub about 1 metre in height, with large bright yellow flowers, which are almost sessile. Native of Mexico, West Indies and South America. *T. ulmifolia* variety *elegans* grows less than $\frac{1}{2}$ metre and bears almost sessile flowers, which are pale yellow, with maroon centre. Native of Brazil. Propagated by seeds or cuttings.

Veronica. (*Scrophulariaceae*): Veronicas are showy herbs, shrubs and rarely trees, which are easily propagated by seed or cuttings or by division and thrive well in any good garden soil with ordinary care. Some species are suited for herbaceous borders, while larger growing species are fitted for cultivating in mixed borders. Several of them make good pot plants. The flowers are usually produced in terminal or axillary bracteate erect racemes. *V. speciosa imperialis* is a handsome

and free flowering shrub, $\frac{1}{2}$ metre high, with purple flowers which are produced in large dense spikes, between July and September. Suited for medium to high elevations.

Venca rosea. (*Apocynaceae*): Dwarf bushy shrub producing numerous showy flowers of rose pink. *Var alba* bears white flowers. Suited for shrubbery and Rock Garden.

Wigandia. (*Hydrophyllaceae*): A large shrub or a small tree. See page 265.

Woodfordia floribunda. See under Grislea.

(B) SELECT ORNAMENTAL FOLIAGED SHRUBS

Acalypha. (*Euphorbiaceae*): A genus of shrubs of great beauty with attractive leaves, variously coloured. They are all easily propagated from cuttings and grown easily. Regular watering maintains them in good condition throughout the year. Pruned back in March-April, they shoot up again into more desirable and compact bushes in the rainy season from July onwards, when they are at their best. Acalyphas are excellently suited for screen planting, for the border, and for pot culture. Some species, as *A. Godseffiana* and *A. Hamiltoniana*, make good ornamental internal hedges or edgings in the garden. At times, Acalyphas are subject to attacks of mealy bugs and thrips and red spider. The following species are recommended :—

A. Godseffiana is low growing with a dense bushy habit and is eminently fitted for making ornamental hedges, 25 to 75 cms. high. The leaves are pretty with prominent yellowish white margins.

* *A. Hamiltoniana*, grows 75 to 100 cms. high; bears small filiform drooping creamy-yellow and green leaves: suitable for hedges and edging. Stands clipping well.

* *A. illustrata* grows about 2 metres high, is a handsome species with very large leaves which are light green, blotched with creamy white.

* *A. Macfeeana* is another notable species with red leaves, blotched with bronze and crimson.

* *A. macrophylla*, height, 2 to $2\frac{1}{2}$ metres; leaves, large, cordate-ovate, russet-brown, blotched with paler spots. A truly grand species.

* *A. macrostachys*, also a very handsome species, the leaves are dark brown, splashed with rosy crimson.

A. marginata, 1.2 to 1.5 metres high; leaves, large, ovate-acuminate; the centre of the leaf is brown and the margin is coloured rosy crimson.

A. obovata is similar in colour to *A. marginata* and has its leaves inverted and oval-shaped.

A. tricolor=*Wilkinsiana* is a very showy species growing 1½ to 2 metres high, having ovate-acuminate very bright looking leaves. The ground colour of the leaf is copper green, which is curiously blotched, mottled, and splashed with red and crimson.

A. musaica grows 1 to 1½ metres high; the leaves are twisted and copper coloured.

Aloysia (Lippia) citriodora. (*Verbenaceae*): Popularly called the Lemon Scented Verbena, A slender stemmed shrub, 1 to 3 metres high, noted for the fragrance of its leaves. Bears long spikes of small white fragrant flowers at the beginning of the cold season. As the old plants are ugly looking, fresh ones should be made by layering every year. A loamy soil mixed with leaf mould and regular watering are necessary for satisfactory growth. In the plains, it can be grown as a pot plant but at medium elevations, it does well in the ground.

Aralia. (*Araliaceae*): Genus of ornamental foliage plants, shrubs, evergreen and deciduous. Great majority of the species are objects of beauty in the conservatory and in the shade garden. Some are very hardy and they can even be planted in open borders with safety. They thrive in sandy loam; a little addition of leaf mould and peat to the soil gives better results. Propagated by cuttings, by layering and occasionally by seed. A large number of species are suited only for medium to high elevations and do not thrive in the plains. In nomenclature, *Aralia*, *Panax* and *Polyscias* are confused with each other. They are very much allied to each other, requiring almost the same kind of treatment. They all prefer to be in small pots and should be shaded from strong sunshine.

The following are a few noteworthy *Aralias*:—

A. (Fatsia) papyrifera (*Rice Paper Plant*): 1 to 2 metres

high; an ornamental plant with the stem branching some centimetres above the ground. Bears a resemblance to the Castor oil plant. The leaves are smooth, 20 to 26 cms. long, and five or seven-lobed. Though the individual flowers are inconspicuous, the plant is handsome when in bloom with the drooping panicles which are 60 to 90 cms. long. From the white pith of the plant, the rice paper of China is made. The plant throws out suckers for some distance around, from which propagation is made.

A. (Fatsia) Sieboldii has fine ornamental foliage rising upon a straight stem forming an umbrella-like head. The leaves are large, digitate and shining green. This species is suited for the shade garden and for the conservatory.

* *A. (Dizygotheca) Veitchii* is a very elegant species with slender erect stem with handsome, digitate, long-stalked leaves. The leaflets are about eleven in number, filiform, undulated and glossy green above and dark red beneath. Requires a cool climate. Propagated from seed.

* *A. (Dizygotheca) Veitchii gracillima* (Syn. *A. gracillima*) is similar to the preceding species, but the leaves have prominent ivory-white mid-rib. With its erect growing, graceful habit, it is excellently suited for table decoration in the young state.

* *A. filicifolia variety variegata* (Syn. *Panax filicifolia variety variegata*) grows 1 to 2 metres, has very showy leaves which are yellow when young. The leaves and leaflets are variable.

A. Balfourii (Syn. *Panax Balfourii*) is a compact, bushy, handsome species growing 1 to 1½ metres high, well furnished from base to top with variegated pinnatifid leaves. Leaflets are oval or rotund and blotched with grey and creamy white.

A. Guilfoylei (Syn. *Nathopanax Guilfoylei*) and its forms are similar to the above species but with smaller leaflets and less of variegation. Also a handsome species, being an erect shrub, 1½ to 2 metres high.

A. (Dizygotheca) elegantissima grows 1 to 2 metres high; is a very ornamental species with straight erect stem, clad at short intervals with digitate leaves on long stalks. The leaflets are 7 to 10 in number, filiform, deep green shaded with

brown, with a mid-rib of greenish white, A very good species for table decoration. Requires a cool climate.

A. Bonnerpi ; A. Massangiana ; A. cordata ; and A. maculata are some other attractive species.

* **Coccoloba platyclada.** (Polygonaceae): Also known as *Muchlenbeckia platyclada*. A very curious plant with flattened stems and branches for leaves, growing $\frac{3}{4}$ to $1\frac{1}{2}$ metres high. Propagated by cuttings.

Codiaeum. Croton. (Euphorbiaceae): The garden Crotons are variegated forms of the unattractive *Codiaeums*. Crotons are ornamental evergreen shrubs with gorgeously coloured foliage, differing in habit of growth and colour and shape of the leaves in the several varieties. They enjoy a great popularity on account of their perpetual beauty and ease of cultivation. They are very useful for screening compound walls, in the shrubbery, on the lawn as specimen plants, and for growing in pots and tubs. They are excellent and invaluable for staging round the house or in the verandah or in desirable situations for effective display. There are a great many named varieties of merit. But, there are more, derived from sports and seeds, which are still unnamed, though they surpass the old standard varieties in point of beauty. The author and K. S. G. Son have been raising hundreds of seedlings derived by crossing good varieties, from which the most attractive ones are picked out. These new varieties of outstanding merit raised by careful and patient selection from seedlings and from sports have won him and others to whom he has distributed these varieties numerous cups and medals in the horticultural shows in India.

K. S. G's New Crotons. The following are some of the distinctly new varieties which the author has raised, named and popularised :—

Anand, Angel, Annie Besant, Asok, Aurora, Bangalore Beauty, Bapuji, Begum of Bhopal, Brilliant, Butterfly, Champion Red, Chandrika, Charm, Chitra, Comet, Compactum, Cream Cupid, Crimson King, Curly Grace, Dazzle, Decorative, Delight, Dilkush, Dream, Ecstasy, Effective, Elegant Enchantress, Emperor, Everbright, Excelsa, Fantasy, Gaiety, Garden Beauty, Gayatri, Gem, Giant, Gita, Glory, Gopal, Gorgeous, Govind, Gurudev, Haemalatha, Hari, Hercules, Javaraya, Jyothi, Kalyani,



Plate 4: BOUGAINVILLEA MARY PALMER

Kamini, Kanti, Kasturi Gopalan, Kasturi Rangan, Kasturi Srinivasan, Komala, Krumbiegel, Leela, Lemonia, Leopard, Little Butter, Lovely, Mammoth, Meteor, M. H. S. Prize Winner, Mohan, Mohini, Monarch, Mukund, Murali, My Joy, Nawab of Bhopal, Netaji, Nobilis, Old Boy, Padmini, Picture, Pink Perfection, Pinky, Prakash, Pretty Darling, Pride, Ramani, Robustum grandifolium, Sarojini, Sensation, Shanti, Sir Mirza, Spearhead, Speciosa, Splendens, Spotted Perfection, Sri Krishna Raja, Sri Narasimha Raja, Srinivasa, Sri Ram, Surprise, Sweetheart, Sumukhi, Suryadev, Thomas Royer, Twinkler, Unique, Vanity, Vatsala, Venus, Victory, Vijaya, Lakshmi, Wild, Beauty, Yellow Giant, Yellow Queen.

The following are the best of the varieties raised by K. S. G. Son after 1955.

Alalu, Anil, Amritha, A. B. Vakil, Arnie Vakil, Annu, Anuradha, Aurora, Red, Adi, Aswath, Atmaram, Abbaiah, V. P. Agnihotri, Balaram, Bapu, Bloodred, Brihmaputra, Brenda, Cauvery, Chellam, Corkscrew, Creamy Wave, C. K. Nayudu, Concerto, Charming Lady, Charming Girl, Charming Lass, Charming Boy, Dr. B. P. Pal, Dr. S. Radhakrishnan, D. N. Krishna Rao, Enchantment, Empress, Fantastique, Fascination, Favourita, Ganga, Gian Chand Jain, Goliath, Gold Crown, Ghulam Ahmed, Golden Eagle, Golden Emblem, Happiness, Heart's Desire, Hyder Ali Mirza, Indira, Jaganmohan, Jagdish, Jamuna, Jayatsen, Jayanna, Jagan Seedling, Jayalakshmi, Krishna, Krishna Swamy, Kailaspat Singhaia, Kousalya, Laila, Lal I, Lal II, Lakshmi, Lady Charming, Lakshminarayan, Lala Amarnath, Latha, Malathi, Manmath, M. O. Mathai, Meena, Mari Gowda, Mrs. Indira Gandhi, Muniswamy, Moon Beam, Narayan, Nirody, Nanditha, Orange Sceptre, Palar, Partha, Prabha, Prakash, Percy S. Lancaster, Prince Charming, Priti, Rohini, Raj, Radhakrishna Ruia, Rajagopal, Rajaji, Ruby, Raghavan, Ramabhadran, Shanthi, Sangeetha, Saraswati, Spot I, Spot II, Spotted Beauty, Sri Kanth, Sulochana, Sunder Raj, Spotted Giant, Symphonie, Sharma, Shantharaj, Spotted Glory, Subbu, Shah Alam, Shobha, Mrs. Savitri Agnihotri, Thirumala, Twizler, Tryambak Pathak, Thayappa, The Sparkler, Vanaja, Vasantha, Vasudev, Varadaraj, Veera, Venus, Wilderness, Yellow Sport, Yellow

King, Yellow Flush.

There are many more recent ones, which are to be named and registered.

The following are some of the varieties of merit which have been introduced by other amateur gardeners, nurserymen and Lalbagh, Bangalore :—

Empire, Jagatmani, Maharaja of Pithapuram, President, Prince Jaya, Princess Vijaya, Rainbow, Ruby Giant, Soundarya, Thousand Bounds, Sanjeevi, Sujayakumari, Indira Priyadarshini, Tiger of Mysore, Tagore, Mahatma, O.B. Special Ramakrishna, Yedyur Giant, Arjuna, Balabhima, Kempe Gowda, Ranganatha, Ranganayaki, Godavari, Vivekananda, Tilak, Hanuman, America Black, Bulganin, China, Chintamani, Dharanappa, Dag Hammerskjöld, Ecafe, Federation, Kengal, Nagarj, Narayana, Gowda, Norodom, Navarathna Paraswanath, Lal Bahadur Shastri, Pandit Nehru, Khrushchev, Zukov, Kamaraj, Harsha, Vinaya, Sumantha, Pushpa.

The following are a few select old standard varieties :—

Acubifolium *gigantium* and its orange species; Alexandra, Barrone de Rothchild, Beauty, Bergmanii, Brageanus, Challenger, Cooperii, Cupidum, Czar, Dayspring, Excelsior, Euterpe, Gladstonii, Goldeana, Henryanus, Imperialis, Imperator, Indian Prince, Lowii, Maculatum, Maharaja of Darbhanga, Maharajah of Mysore, Maharani Regent, Mooreanus, Mutabilis, Prince Albert Victor, Prince of Wales, Princess of Wales, *Recurvifolia*, Reidii, Rosea, Shepherdii, Schomburgiana, and its orange and golden varieties, Sir Ashly Eden, Sir William McArthur, Sunrise, Sunset, Trilobus, orange and yellow species, Victoria, Versicolor and Variabilis.

Those interested in raising Crotons from seeds may find the following hints useful. Female and male flowers are borne in different clusters, which are easily distinguishable. Fertilise female flowers with pollen collected from favoured varieties. Seeds which are the result of natural fertilization yield a very large percentage of very inferior almost green leaved plants. Bag the clusters when they are ripe or the capsules burst scattering the seeds. Sow the seeds fresh after drying them for a day or two in the sun. Germination is slow and irregular. When the seedlings are 15 cms. high,

pot them separately or put them out in nursery beds 45 cms. apart. Transfer the plants to bigger pots as they outgrow the pots they are in. In 2 to 2½ years, the plants should develop colour, if not earlier, when a selection may be made from them for propagation. When the plants are sufficiently grown to furnish cuttings or to be layered, raise new plants from them, as these have a better root system than the original seedlings and grow quickly.

Crotons are ordinarily increased from cuttings, 15 to 20 cms. long, with the bud not opened out are put each into a 10 cms. pot in a mixture of equal parts of sand and leaf mould and the pots put in a frame over a hot bed. In about 2½ months, they emit roots and could be shifted to 15 cms. pots using richer soil containing red earth and horse manure in addition. Cuttings of old wood, cut up into bits of about 15 cms. also strike roots but not so quickly as terminal cuttings. The best time for propagation from cuttings is August to September, when one may expect cent per cent success. Crotons are layered ordinarily like other shrubs. Small or large healthy plants are straightaway obtained by gootying at the firm portion towards the end of shoots. For this purpose, a bamboo receptacle can be used as shown in Figure 42. The best method to gooty is to wrap a bit of gunny bag round the portion ring-barked and to put in it a mixture of equal parts of red earth and sand and tie up firmly. See Figure 41. For propagation, it is advisable to choose only particularly bright shoots of the plant. Dull coloured shoots, very often do not improve in colour with age.

Crotons thrive best in a warm moist climate, as the one which prevails at Trivandrum. They do not stand frost and do not thrive on hill stations, where they may only be grown in pots inside conservatories or glass houses. They enjoy full morning sun and develop rich colours only where they get plenty of morning sun and partial shade during the rest of the day. Some varieties, especially the small leaved kinds can stand sun throughout the day. But generally, all kinds can be put into the open sun where they harden themselves in course of time though their foliage may be scalded to start with. Too much shade results in comparatively large colourless

leaves. The soil should be well drained. The compost recommended in page 129 is used for pot plants. Potting should be firm and planting, not too deep. Addition of lime to the soil helps to keep it sweet and improve the colours. This should not be done, however, till after a month or two after repotting or top-dressing with manure. Bone meal mixed along with the compost helps to maintain the plants for a long time in good condition. Repotting is best done once a year. Topdressing with a mixture of red earth and horse manure every three months keeps the plants healthy and in vigorous growth. Syringing the plants every other day during the cool hours helps not only to keep the foliage fresh but also to keep in check thrips and red spiders, which defoliate the plants, should they get the upper hand. The only serious pests of Crotons are these insects and mealy bugs. Plants infested should be segregated from others and treated suitably. Rub off the bugs from the parts affected and sponge them with a dilute solution of fish oil soap or better still with methylated spirit to kill the young of the bugs. Thrips and red spider are effectively controlled by spraying thoroughly the foliage, especially the reverse side where the insects suck the sap from the leaves, with tobacco water. Two or even three sprayings at intervals of a week may be necessary to eradicate the pest completely, which otherwise spreads rapidly from plant to plant, entirely defoliating all the Crotons in the garden.

As Crotons are grown for their foliage, the aim should be to make large attractive bushes of them with leaves from top to bottom. To achieve this object, the plants should be pinched or cut back when they are only 15 cms. high in small pots to produce a number of shoots to serve as framework for the bush in course of time. When the new shoots grow 20 to 30 cms. or more, they should again be cut back suitably to produce new shoots, to avoid the plants from getting 'leggy'. Old plants which have become leggy or bare at the bottom portions may be cut back in July–August to be turned into presentable shrubs with fresh crowded foliage within six months.

Duranta Plumieri variegata. See page 290.

Eranthemum. (Acanthaceae): Small shrubs, $\frac{1}{2}$ to 1 metre high, with attractive foliage, consisting of coloured leaves, thriving in semi-shady situation. Some of the species bear very attractive flowers. For bushy and handsome plants, the shoots should be frequently cut back. Almost all kinds are suited growing as ornamental hedges or in pots or in the shrubbery in the shade garden. Propagated easily by cuttings.

E. cinnabarinum, $\frac{1}{2}$ to $\frac{3}{4}$ metre high, leaves deep green, with yellowish veins. A handsome species.

E. Goldeana=*E. eldorado*, $\frac{1}{2}$ to $\frac{3}{4}$ metre high, leaves, yellow mottled and veined with green.

E. nobilis has leaves green, with yellow veins. Useful for ornamental hedging.

E. tricolor has olive green leaves, blotched irregularly with greyish purple and salmon-pink tints, more or less varied.

* *E. versicolor* is very pretty, the leaves being variegated white and green. Excellent pot plant.

* *E. atropureum* has leaves with deep bronze or purplish variegation.

* *E. albomarginatum*, *Moorei* and *argenteum* are others.

Erythrina. (Leguminosae): Of its species, which are grown for their handsome foliage, are the following two:—

* *E. indiea* var. *Parcelli* is a small tree large, soft quick growing shrub about $2\frac{1}{2}$ metres high, with very ornamental variegated foliage, consisting of trifoliate leaves marked by cream-yellow bands running along the main and central veins. Flowers are bright orange-red, produced in tufts at the ends of the branches. Propagated by cuttings. For shrubby appearance, the plant should be cut every year.

* *E. vestpertilio* grows to about $1\frac{1}{2}$ metres high, with graceful appearance. Foliage consists of dark green handsome trifoliate leaves. The leaflets are sharply acuminate and small.

* **Evodia elegans.** (Rutaceae): Small ornamental ever-green shrubs, $\frac{1}{2}$ to $\frac{3}{4}$ metre high with dark green graceful foliage of large pinnate (three-foliate) feathery leaves, which leave an aromatic odour when bruised. Small whitish flowers are produced in terminal panicles, which are followed by capsules with glossy black seeds inside, from which the

plants are propagated. The shrub is a native of New Guinea and it resembles *Aralia elegantissima*. It is useful for planting in shade gardens or in pots for adornment of the conservatory.

Excoecaria bicolor. (*Euphorbiaceae*): A moderate-sized (1 metre high) shrub, beautiful with its foliage of small ovate-lanceolate leaves, which are deep olive-green above and deep purplish red below. The flowers are inconspicuous. A plant for growing in shade or semi-shade, either in pot or ground. The leaves are used for making bouquets. Propagated by cuttings in the rainy season.

Graptophyllum. (*Acanthaceae*): Graptophyllums are called Caricature Plants. Very much like Eranthemums. They are useful in the shrubbery and as pot plants for decoration and thrive in partial shade. * *G. hortense* is a small compact shrub, $\frac{3}{4}$ metre high, with leaves fairly large, elliptical, variegated, blotched green and creamy white or bright yellow. Very much valued for its ornamental foliage. *G. hortense* variety *picta* grows about $\frac{3}{4}$ metre high, has dark red leaves, with pink blotches. Propagated by cuttings easily.

Gynura aurantiaca. (*Compositae*): Is an attractive herbaceous shrub, $\frac{1}{2}$ metre high, with pretty foliage of ovate iridescent leaves which are violet-purple in colour, on account of the velvety hairs of the same colour with which they are clothed. *G. bicolor* is a slightly larger shrub. Both are easily cultivated. Propagated from cuttings.

Iresine (Syn. Achyranthes). (*Amarantaceae*): (Blood-Leaf). Iresines are sub-tropical bedding plants of great beauty with bright coloured foliage. They are very easily raised by cuttings. They are herbaceous, small shrubs growing $\frac{1}{2}$ to $\frac{3}{4}$ metre high, and withstanding shearing pretty well, thus making them suitable for edgings and ribbon borders. They are very serviceable in the shrubberies too. The flowers, which are unimportant should be removed. There are several species, the most showy being the following:—

I. Herbstii. (Syn. *Achyranthes Verschaffeltii*) $\frac{1}{2}$ to $\frac{3}{4}$ metre high; leaves are two-lobed at the apex and are of a bright crimson and maroon colour with whitish veins. Colours develop better if protected from severe sun.

I. Herbstii, variety *aureo reticulata* is also pretty, with greenish leaves, with red and golden veins.

I. Lindenii has blood-red leaves and grows about 30 cms. high.

Nandina domestica. (Berberidaceae): A handsome dense shrub, 1 to 1½ metres high, with a number of cane-like stems clothed with light feathery bi-pinnate leaves. The leaflets are small, narrow, myrtle-like and tinted bronze. The flowers are creamy white in colour and they are bronze in stiff erect panicles at the ends of the branches or the stems. The flowers do not contrast well with the graceful foliage, which makes the shrub handsome. The plant does not quite satisfactorily thrive in the plains but it does well at medium elevations. It requires partial shade, especially in summer. Easily propagated by seeds or by division of suckers from the base.

Panax. (Araliaceae): Very useful plants with graceful evergreen foliage, very much allied to Aralias. They are very serviceable as pot plants, for planting in shade gardens, for screen planting in shady situations, and in the shrubberies. Their culture is the same as that of Aralias (See page 318). The leaves are often very finely divided and in several species, variegated with white or cream-yellow. For pot culture, they should be grown in undersized pots. Easily raised from cuttings. New varieties are got from seeds. In nomenclature, Panaxes and Aralias are often confused with each other. The following species and their varieties are recommended.

* *P. fruticosum* is an erect shrub, about 2 metres high, with elegant much divided leaves, which are pinnately bicom-pound and have a soft appearance. *P. fruticosum* variety *plumata* is very pretty.

* *P. Mastersianum* grows about 90 cms. high and has highly ornamental leaves.

P. Vicioriae. Has a graceful, compact habit with recurved mass of variegated foliage. The leaflets are light green and edged with cream-white. An excellent plant for table decoration.

P. Guilfoylia with its varieties *lacinata*, *monstrosa* and *Victoriae* are all very ornamental plants.

* *P. Lancastrii* is very handsome with bright cream and light green variegations in broad blotches. Leaves are almost round.

* *P. filicifolium* ; *P. Massangiana* ; *P. rotundus* ; * *P. Veitchii* ; *P. elegans* and *P. crispum* are other attractive species.

* ***Phyllanthus nivosus* var *roseopictus*.** (Euphorbiaceae): A shrub, about 90 cms. high, with very attractive foliage consisting of pinnate leaves, which are 22.5 to 30 cms. long. The leaflets are small and variegated with green and blotches of white, pink and rosy-purple colours. The tender shoots and branches are rosy purple in colour. The shrub is very attractive grown in semi-shade and it is at its best in August. Makes a very handsome pot plant. Propagated by cuttings and by separation of suckers from the base. Sometimes subjected to attacks of mildew.

Podocarpus. (Coniferae) : A family of evergreen dwarf trees or shrubs, with stiff linear leaves. They are of very slow growth and are useful for planting on lawns as single specimens. Propagated by cuttings or by layering in the rainy season. *P. latifolia* ; *P. chinensis* ; *P. neglectus* ; and * *P. taxifolia* are some of the attractive species.

***Ricinus communis*.** (Euphorbiaceae) : Castor-oil Plant. It grows about 2 metres high. Though it is a common economic shrub, it is ornamental with its large, dark green, palmate leaves. There is a variety with purple-bronze leaves, which is more handsome than the common kind. Grows like a weed in any soil and is easily raised from seed. There are some more ornamental varieties.

* ***Sanchezia nobilis variegata*.** (Acanthaceae): An evergreen very handsome, spreading shrub, one metre high, with long lanceolate leaves which are brightly banded or veined with creamy white or yellow and tinged with red occasionally. The flowers are yellow with red bracts and they are produced in dense terminal racemes. The shrubs do well in semi-shade and shady situations, being useful for planting in shade gardens and in the shrubbery under the partial shade of large trees. A native of Ecuador. Easily raised from cuttings.

* ***Strobilanthes*.** (Acanthaceae) : *Strobilanthes* are dwarf shrubs of easy culture. Some species are grown for their ornamental foliage and some for their attractive flowers.

* *S. Dyerianus* is a very pretty, herbaceous foliage plant of trailing habit, $\frac{1}{2}$ metre high, with leaves which are reddish

purple, shaded with bronze and green and silvery white. The flowers are pale purple and are not much. The plant is useful for filling up beds in shade gardens or for growing in pots for the decoration of conservatories. Propagated by cuttings.

S. anisophyllus, called the Gold Fussia is a native of India ; it is a small herbaceous shrub, $\frac{1}{2}$ to $\frac{3}{4}$ metre high, with unequal, lanceolate, shining, dark green leaves. The flowers are lavender coloured and they are borne in cymose heads. Thrives in semi-shade only. *S. gossypinus* and *S. isophyllus* are other flowering species, which are suited for medium elevations.

Thunbergia Kirkii. (Acanthaceae) : A small shrub of formal and attractive appearance, $\frac{3}{4}$ to 1 metre high, with slender rigid divaricating four angled stem and branches and close set small pinnate rigid peculiar leaves. Flowers are violet blue, and *Meynia*-like in shape, produced not too freely.

CHAPTER XIX

ORNAMENTAL FOLIAGE PLANTS

Under this heading, for purposes of convenience, are treated ornamental foliage plants of a miscellaneous character which are not dealt with elsewhere. Mostly, they are cultivated in pots in shade or semi-shade, in conservatories, verandahs, etc. Some of the kinds listed are useful otherwise for edging, for planting on rockeries, for growing in hanging baskets or for planting out in shade gardens.

Aglaonema. (Araceae): Succulent or shrubby perennial valuable pot plants with leaves, variegated or green blotched with grey. Thrive well in shady and semi-shady situations only, as ferneries or plant-houses. Require a soil composed of loam, leaf-mould, sand, charcoal and old mortar. (See page 150, Compost No. 11). Aglaonemas are allied to Arums, Alocasias and Dieffenbachias and require essentially the same treatment as they do. Daily syringing of the foliage improves their appearance and condition. They are easily raised by terminal or node cuttings of the stem and by division of the basal shoots. Natives chiefly of Malaya and Philippines.

The following are a few noteworthy species:—

A. commutatum, a dwarf plant about 25 cms. high, Maranta-leaved, spotted and greyish blotched.

A. costatum, a very dwarf and compact, very showy species. Leaves are thick, heart-shaped, about 7 cms. wide and 10 cms. long, dark shining green with ivory white scattered blotches. A native of Perak.

* *A. pictum*, also a dwarf species, 25 to 50 cms. high, with elliptic-accuminate, light green leaves, which are irregularly blotched with broad grey patches. The stems are slender and erect. A native of Sumatra and Malaya.

* *A. versicolor* is 45 to 50 cms. high and is very similar to the above species but has smaller leaves.

A. hospitum is spear shaped, leathery, glossy, ovate leaves with white spots.

* *A. hospitum variegatum* - a richly mottled species of the above.

* *A. oblongifolium curtisii* has dense bluish green long elliptic leaves with silvery feathery design.

* *A. Pseudo bracteatum* very colourful, with long showy leaves deep green variegated with white and light green, centre being creamy white. White and marbled green stem.

A. rotundum is a very delicate but pretty dwarf variety with leaves broad-ovate or rhombic, metallic green with prominent pink midrib.

* *A. roebilini* (*Schismatoglottis*). Very snowy, large, leathery leaves largely variegated with silver on greyish green, ovate pointed.

* *A. treubii* is a slender plant with narrow leather bluish green leaves attractively blotched silver grey.

Alloplectus. (*Gesneraceae*): *A. Lynchii* grows about 45 cms. high with handsome bronze-coloured leaves, which are purple underneath. A pot plant for the conservatory. Raised by cuttings. Native of Columbia.

Alocasia. (*Araceae*): *Alocasias* rank high among ornamental foliage plants. Closely allied to *Caladiums* and *Colocasias*. Very useful for decoration of conservatories or plant-houses, verandahs, etc. Many species have large, coloured and variegated leaves with rich metallic hues. Some species have them green or green and white with prominent veins and markings and blotches. They are usually peltate, more or less oval-triangular in shape with a deep sinus at the base. The under surface is generally distinct in colour from the upper surface. Leaf-stalks are in many species beautifully marked or blotched. The stem is thick, short and densely marked with leaf scars; it is usually tuberous or rhizomatous rooted. Most species rest for a time after a distinct period of active growth.

Alocasias are easy of cultivation, thriving well in open well drained soil, Compost No. 9, page 127, being suited for pot culture. During active growth, which in most species is from April to November, watering should be liberally done. Though in several species, the foliage does not die down completely in winter, it is best the water supply is

then much reduced to the plants, as otherwise the tubers or rhizomes would rot away. Old plants cut back to the soil-level or to 5 cms. above it, give rise to a number of shoots rich in fresh foliage. Propagation of *Alocasias* is made by node cuttings of the stem, each piece with a bud being placed in moist sand or by tubers produced at the ends of roots or cuttings of rhizomes. Some species may also be raised from seed. The inflorescence is a spathe and it is unattractive; it should be removed to encourage fresh and handsome foliage. The following species deserve particular mention:—

A. argyrea: About $\frac{1}{2}$ metre high with large leaves which are dark green with a silvery sheen. Makes a handsome plant with crowded foliage.

A. cuprea has petioles $\frac{1}{2}$ metre or less long, with ovate-peltate blade, 45 by 30 cms., dark metallic green with darker veins and ribs above and rich purple on the underside. Native of Borneo.

A. Johnstonii (Syn. *Cyrtosperma Johnstonii*) presents a unique appearance. Leaves are semi-erect, arrow-shaped and peltate, olive green in colour, prettily variegated and strikingly veined with bright rosy-red. Leaf-stalks are furnished at intervals with whorls of stiff spines. Stem is densely mottled with bands of flesh colour just above the spines.

A. Jenningsii is a handsome species, growing $\frac{1}{2}$ to $\frac{3}{4}$ metre, with leaves 20 to 25 metres long and nearly as much wide. The ground colour of the leaf is a beautiful shade of glaucous green, which is set off by oblong patches of almost black.

* *A. Lindeni* grows about $\frac{1}{2}$ metre high and is furnished with broadly arrow-shaped leaves, which are green with yellowish veins, curving off from the pale yellow midrib and vanishing near the margin. Petioles are nearly white. A noble species, native of Papua.

* *A. macrorhiza variegata* grows about $\frac{3}{4}$ metre high with cordate large leaves, which are pale green with large portions of them blotched with creamy white and white. Some leaves are completely white. Native of Ceylon. A truly handsome species. Propagated by suckers or offsets.

* *A. metallica* = *A. cuprea* is very pretty with leaves of

deep metallic hue. Grows about 45 cms. A very rare plant.

* *A. Sanderii* is a native of the Philippines growing about 60 cms. high. Leaves are arrow-shaped with scalloped edges and broad prominent white margins and nerves. A very attractive species.

* *A. Lowii* growing about $\frac{1}{2}$ metre high, very attractive when in full growth. Leaves are cordate-sagitate, 35 to 40 cms. in length, olive green with thick white midribs and deep purple underneath.

A. Portei: See under Schizocasia.

* *A. singaporensis*: A very pretty species, triangular leaves, fine silvery grey above and purple below. Attractive.

A. Thibautiana=*A. spectabilis* is a native of Borneo 45 to 50 cms. high with leaves about 50 cms. long by 45 cms. wide, of deep olive green above with silvery-white nerves branching from the midrib and purple underneath.

A. violacea has leaves of rich metallic hue.

A. zebrina has light green leaves with long prominent petioles which are beautifully marked with zig-zag transverse dark bands. A very desirable species. Native of Manila.

Alocasia esculenta is large growing and distinctly tuberous rooted. Leaves are large and green. The species is grown on a large scale by market-gardeners for its tubers, which are used as a vegetable by Hindus. (Called Sanekilangu in Tamil and Samegedde in Canarese).

These are some of the recent introductions which deserve special mention.

* *A. amazonica* is a very elegant species, a free and bushy grower having leaves dark green with scalloped edges, veins contrasting white. Grows to $\frac{1}{2}$ to $\frac{3}{4}$ metre.

* *A. Chantrieri* is a bushy plant with, olive green, peltate-sagitate leaves, with pearl grey white veins and scalloped white margins.

* *A. 'Hilo Beauty'* is a lovely species growing to $\frac{1}{2}$ metre, having blackish purple stalks, and medium green leaves marked irregularly with blotches of light cream yellow or light green.

* *longiloba* is widely arrow shaped leaf bluish green, veined and margined grey white. $\frac{3}{4}$ to 1 metre high.

A. lowii grandis is broader than *A. lowii* with veins more silvery grey.

A. regina has a very prominent blackish stalk or brownish purple with olive green leaves, the underside greyish maroon.

* *A. watsoniana* has large corrugated leaves, leathery, blue green to silvery grey with silvery white veinings.

Alpinia. (*Zingiberaceae*): Genus of hardy foliage plants, with ginger-like roots and attractive foliage, useful for mass effect, planted by swampy corners and in low ground. Propagated by division of clumps of rhizomatous roots. *A. Sanderæ* is very handsome and popular as a pot plant, used for decoration of plant houses, with stems about $\frac{3}{4}$ metre high, covered with short lanceolate leaves, which are green obliquely regularly marked with broad stripes of dark green and white. *A. vittata* has its leaves striped creamy white. Requires lot of water while growing. If soil is very rich, variegations do not develop satisfactorily. Flowers are in spikes and are not much.

Ananas. (*Bromeliaceae*): Ananas or Pineapples are well known fruit plants, the foliage of which is handsome even in the orchard types. There are some variegated leaved kinds which are particularly ornamental and striking. They are grown in pots for decoration of vases. They are hardy and thrive in rich well drained open soil. Propagation is from crowns of fruits or suckers from the base of the plant, which should be kept away for two or three days before planting in sand. Rooted young plants are placed in 15 cms. pots with the lower leaves removed and only shifted to larger 25.5 cms. pots when they are full of roots.

The following variegated kinds are recommended:—

* *A. sativa variegatus* grows about 45 cms. high. The leaves are nearly $\frac{1}{2}$ to $\frac{3}{4}$ meter long, beautifully arched and variegated and set with recurved spines at the edges. The centre of the leaf is rich green, with occasionally a few lines of white, and it is margined with rich creamy yellow, tinged with red towards the margin, especially when the plant is exposed to the sun. A very decorative vase plant.

A. sativa striatifolia has striped leaves, marked longitudinally with primrose, red and green stripes.

A. Porteanus is another very desirable species, with leaves

armed with spines on the margin, deep olive in colour with broad band of pale yellow extending down the centre from base to apex.

Anthericum. (*Liliaceae*): Dense foliaged herbs, with mostly fleshy, linear-lanceolate leaves, which are gracefully recurved, springing from the short root-stock. Loose panicles of flowers are thrown up from the latter. The variegated species are very pretty and they are largely used in carpet bedding, for edging, for culture in vases and baskets. Grown in pots, they are very useful for adornment of the conservatory. Anthericums require a sandy loamy soil and plenty of water. They thrive in shade and semi-shade. Propagated by division from offsets and from seed. Very often, the ripe flower-stalks carry young plants with a well developed root system, and these may be severed and straightaway potted in 12.5 cms. pots.

A. variegatum (Syn. *Chlorophytum elatum variegatum*) has very handsome foliage of striped, white and green leaves. Thrives at medium to high elevations. A hardy and serviceable plant. There are three or four varieties of this species with differences in variegations on the leaf.

A. liliastrum bears bell-shaped, fragrant white flowers. It grows to 30 cms. with variegated foliage and thrives only in up-country. Popularly known as "St. Brunos' Lily."

Anthurium. (*Araceae*): A large genus of tropical aroids. They are conveniently grouped to fall under two sections, (1) the foliage section with velvety ornamental foliage and (2) the flowering section bearing interesting flowers. The leaves of the foliage section are strikingly ornamental; they are bold in outline, large, suspended from a strong stalk, velvety. They vary in their tints and are in some species tinted with metallic hues relieved by veins and midribs. The flowering group is grown for the attractive inflorescence which consists of a bright hood-like spathe of rich crimson or rose or cream or white encircling the spadix. The foliage in this section too is handsome but only not so very attractive as in the preceding section.

Anthuriums thrive in open well drained soil, humid atmosphere and a shady situation. Compost No. 12, page 127, suits them best. They should be grown in pots in conser-

vatories. Old ill-looking leaves should be removed, as also the flower stalks as they come up, in the foliage type. The young satiny leaves should not be syringed very hard nor bruised. As the plant grows in the pot, roots which are formed on the stem get exposed and harden and cannot sustain the plant in good condition. They should be covered with the compost or neatly mossed up. If the stem grows too long, the plant is best repotted, cutting it back and starting it on fresh roots. Propagation is by node cuttings or bits of rhizomes, or by division of suckers. All the species, the flowering and the foliage kinds, grow well during the rainy season. All are moisture loving.

The following are the more attractive flowering species :—

* *A. Andreanum* : A very pretty species being in bloom for nearly three months, $\frac{3}{4}$ to 1 metre; large handsome satiny leaves; spadix is 7.5 cms. long; the spathe is open, leathery, 7.5 to 10 cms. across and 15 to 22 cms. long, scarlet in colour. A native of Columbia. *Var. Alba* has white spathes.

A. Brownii has rose-tinted spathe.

* *A. scherzerianum* and *A. Regenellianum* have intense red spathes.

The following foliage kinds are recommended :—

* *A. crystallinum* grows $\frac{1}{2}$ to $\frac{3}{4}$ metres high, with very large leaves which are ovate-cordate-acuminate, bright rich velvety green, with the principal veins elegantly banded with pure crystal white. The young leaves are very delicate and tender and violet purple in colour and should be protected from coming in contact with rough objects, lest they should be soiled. Native of Peru. There are two varieties, in one the leaves are broader than in the other.

A. digitatum has palmately divided leaves, grows $\frac{1}{2}$ to $\frac{3}{4}$ metre.

* *A. Veitchii* is a handsome striking species. The leaves are $\frac{1}{2}$ to $\frac{3}{4}$ metre long, obviate-oblong in shape, furrowed transversely, and deep, rich green in colour. A truly lovable plant. Native of Columbia. There are two types in this species, one with a broader and longer leaves.

* *A. Warocqueanum* is also from Columbia, a very ornamental striking species. The leaves are elongated, $\frac{1}{2}$ to $\frac{3}{4}$



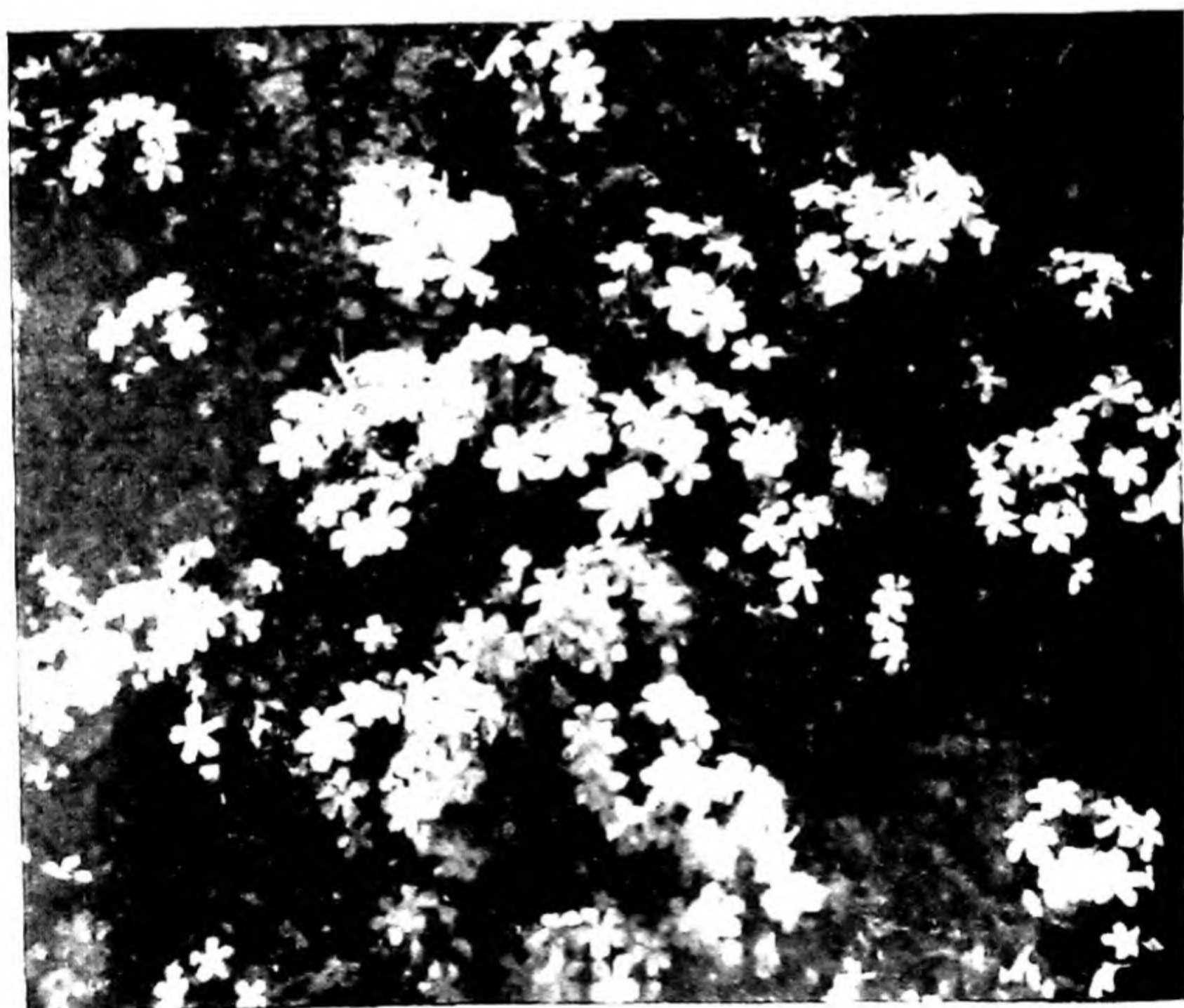
CROTON. K.S.G'S METEOR



CROTON. K.S.G'S GLORY



CLERODENDRON KAEMPFERI



A HEDGE OF PLUMBAGO CAPENSIS

metre long, 20 to 30 cms. broad, are deep velvety green. The midrib and veins are of lighter colour and pleasingly contrast with the green portion of the leaf. Young plants from stem cutting bear small leaves. Plants derived from the terminal cuttings of large plants bear magnificent large leaves soon.

* *A. magnificum* is very handsome with its large leaves, which are $\frac{1}{4}$ to $\frac{3}{4}$ metre long and about 45 cms. wide, cordate-acuminate in shape, with the leaf-stalks, $\frac{1}{4}$ to $\frac{1}{2}$ metre long. The colour of the leaves is velvety green; the veins contrast well with the colour of the leaf.

A. grande; *A. insignes*; *A. macrolobum*; *A. pandurifolium*; *A. radiatum*; and *A. splendidum* are some more desirable and notable species.

Asparagus. (*Liliaceae*): A large genus of herbaceous perennials, tender woody shrubs and vines, with ornamental foliage. One of the species, *A. officinalis* is used as vegetable. The plants are provided with underground rhizomes, from which the aerial shoots arise in regular order. The roots of several species are tuberous, fleshy and cylindrical. The leaves are reduced to scale-like bracts, usually with a basal spur, which is often spiny. The function of the leaves is taken up by the cladodes, which are leaf-like structures. The flowers in several species are fragrant, but are not much in appearance. The following species are recommended:—

A. plumosus is called the Asparagus Fern. It is a very ornamental, evergreen, small climber, with slender smooth stems and numerous spreading branches and graceful needle-like foliage. The pseudo leaves are dark green and very handsomely divided and grouped in tufts, resembling fern fronds. Flowers are very small and insignificant. A light rich soil, good drainage, semi-shady situation and a good supply of water are needed for successful culture. It is an excellent plant for growing in a pot over a balloon or for adorning a trellis on the porch, growing 2½ metres or more. Propagated by seed or by division. The seeds are hard and hence germination is slow. In floral decorations, the foliage is used similarly as the fronds of ferns. *A. plumosus nanus* is a dwarf variety of the above and it is a more satisfactory plant for pot culture.

* *A. Sprengeri* has elliptic tuberous roots. The stems are numerous and do not climb more than 1.25 metres. The flowers are very fragrant, produced in 2 to 8 cms. long racemes. A very hardy species, very useful for planting in hanging baskets and on rockeries for creeping along the nooks and corners. The foliage is used for making wreaths and in floral decorations. The variegated species with white and green leaves is a rare plant. Does not develop variegation in very rich soil.

A. racemosus is a scandent shrub, bearing very fragrant white flowers.

A. myriocladus is dwarfish in size, growing only about 45 cms. with very short leaves gathered in numerous brush-like whorls. A good pot plant.

Aspidistra. (*Liliaceae*): Foliage plants of great merit, with radical, stiff, shining, beautiful foliage, sometimes called the Parlour Palms. They are very hardy, withstanding hard usage, dust and heat and they are hence very popular house plants. With cut flowers, the leaves are used for table decorations. They thrive best in rich loam, containing leaf-mould and sand, like plenty of moisture and half-shade. Propagated by division. Shake out the old soil, while repotting, putting several pieces with roots into pots of suitable size. The variegated kinds lose their colour in very rich soil.

A. lurida is the commonest species grown. It is 30 to 45 cms. high, with oblong-lanceolate leaves which are 30 to 45 cms. long and 45 cms. broad. Serves as border or edging plant; does well in pots or in the ground. * *A. lurida variegata* is a variegated variety of the above, the leaves being white and green; a very pretty foliage plant, which is apt to revert to the green type. Native of Japan. The plants do better when roots are fairly well confined and hence pots not too large are to be used. Omission, however, to divide and repot when the pots are too full of roots will cause them to sicken and die.

* **Beaucarnea** (Syn. *Pincenecttia*). (*Liliaceae*): Very ornamental, graceful, slow growing, Dracaena-like, Mexican plants, with long, narrow, green leaves and slender woody stems with a remarkably swollen tuberous-looking base. The plants

form striking objects in the conservatory or in the open in sheltered situations. They should be potted in a compost consisting of equal portions of red earth, sand, leaf mould and manure and provided with ample drainage. Propagated from seeds imported from their native country (Mexico). The plants are rare and difficult to obtain.

B. recurvata (Syn. *P. tuberculata* and *Nolina tuberculata*) is a beautiful object, wherever it is placed, with its pendulous bright green leaves. Its swollen ball-like basal part of the stem placed above the level of the soil while planting enhances the ornamental value of the plant.

B. longifolia is also a beautiful species with leaves about 1½ metres in length, which are narrow, pendant. Native of Mexico.

* **Begonia.** (*Begoniaceae*): There are some begonias which have very ornamental foliage. They are very useful for pot culture. See under Begonia in Chapter XXV.

Billbergia. (*Bromeliaceae*): Genus of dwarf epiphytic ornamental plants, with thick succulent hard and rigid, stem-clasping, long, convolute leaves. The flowers are usually borne in erect spikes, one in the centre of each plant. The plant or the shoot dies after flowering and fresh suckers are produced which flower later. Bracts of the flower clusters or usually very brightly coloured and showy. The plants are usually grown in pots or on rockeries or like orchids on tree trunks. Perfect drainage, shady situation and friable soil made up of loam, sand, leaf-mould and manure in equal proportions with addition of charcoal and brick pieces, are necessary for their successful cultivation. Propagated by suckers. The sucker is taken by the hand and is twisted off the stem gently, the base is then trimmed and a few bottom leaves are cut away and the sucker inserted in sharp soil in a small 10 cms. pot. For raising a number of plants, seeds are sown; but this method is very slow. Many species are in cultivation:—

* *B. rosea*; ½ metre high, with erect rigid convolute leaves, banded and blotched with grey and bronze. Flowers are rose-pink on long spikes. Native of Tropical America.

B. speciosa, leaves ½ to ¾ metre long, forming a tube at the base, green above and somewhat striped on the back. Flower cluster is large, loose and drooping. The bracts are

rose coloured, the flowers being pale green or whitish, tinged with blue.

* *B. zebrina* is about $\frac{1}{2}$ metre high, with leaves sheathing for about half their length, forming a sort of a tube. The colour of the leaf is green with zones of grey, deepening with age. Flowers are greenish, and the bracts are very large and bright salmon-coloured. The inflorescence is very gracefully turned downwards.

B. escapa is a pretty species, 30 to 40 cms. high. The leaves are dark-blackish-green above and purple underneath and tipped with rose colour. The flowers are not much.

B. nutans; *B. pyramidalis*; *B. Sanderiana*; *B. thyrsioides*; *B. zonata* are other noteworthy species.

Caladium. See Chapter XXVI.

Calathea: See Chapter XXVI.

Caraguata. (*Bromilaceae*): Some attractive species as *C. Andreana*, *C. musaica*, are put to the same use as Billbergias, which they resemble.

Cardulovica. See under Cyclanthus.

* **Coleus.** (*Labiatae*): Small, highly decorative, herbaceous plants, $\frac{1}{4}$ to $\frac{1}{2}$ metre high, with gorgeously coloured foliage, a source of constant joy. They are very valuable pot plants. Some species can, however, be used as edgings or for filling carpet beds. Propagated easily by terminal cuttings or seeds. Slips strike root in a month. Pot the rooted cuttings singly in 15 cms. pots firmly, using Compost No. 1 on page 126. Nip the tops of growing shoots once or twice to make the plants bushy and give them form. Water carefully at first, and then very liberally as growth progresses. Shade the plants from severe afternoon sun. As the small pots are filled with roots, shift the plants to 22.5 cms. pots using similar compost. Apply liquid manure of horse dung once in ten days. Firm potting contributes to healthy, strong, close jointed plants. Remove flowers as they appear. In about three months after potting the cuttings, big-sized show specimens, are obtained. Plants grown from seedlings are better looking and are larger leaved than those from cuttings. A large number of differently coloured new varieties may be raised by sowing a mixed packet of seeds. Coleus are attacked by a whitish

scale insect which is rather difficult to eradicate. The best thing that could be done is to burn the plants, if the attack is very severe; but if there are only a few insects noticeable, here and there, on the plant, they can be gently washed away with fish-oil-soap solution. Colours of the plants develop, when they get pot bound. *C. Hendersoni* with bright red leaves margined yellow is very good. *C. pumilus* = *C. Rehnelianus* has creeping stem frequently rooting from the nodes. It grows only 20 to 25 cms. high. Leaves are small, bright green with large purple blotch in the centre. Very suitable for hanging baskets, edging small beds, or for carpet bedding. *C. thyrsoides* is a beautiful herb bearing large spikes of charming blue flowers.

Cordyline. See under *Dracaena*.

Costus. *C. speciosus* is an attractive foliage plant. See Chapter XXVI.

Cryptanthus. (*Bromeliaceae*). Dwarf Perennial stemless epiphytic plants, about 15 cms. high, with stiff leaves in rosettes. Natives of Brazil. Grown in pots or on rockeries. Propagated by offsets inserted singly in sand in 15 cms. pots. *C. Beuckeri*; *C. undulatus*; *C. undulatus* var. *zebrinus*; *C. zonatus* are recommended.

Curculigo. (*Amaryllidaceae*): The species usually cultivated is *Curculigo recurvata*. It is a stemless Tropical Asiatic foliage plant, with leaves which are long and furrowed and palm-like in appearance. It is hardy and easily cultivated, either in pots or in the ground. The soil should be well drained and watering should be regular and plentiful. Propagated by suckers forming at the base of the stem. A variegated variety of the above species, * *Curculigo recurvata variegata*, is a very handsome plant for indoor decoration or for the fernery. The leaves, which are upwards of $\frac{1}{2}$ metre long and 15 cms. broad, are bright green in colour and are banded with stripes of white longitudinally.

Cyanophyllum. See under *Miconia*.

Cyclanthus. (Syn. *Cardulovica*). (*Cyclanthaceae*). Palm-like plants of Tropical America. They are usually stemless and have large leaves, which are long-stalked and resemble plam-leaves. *Cardulovicas* are plants suitable for culture in

large pots or tubs in conservatories, with an assured plentiful supply of water. Propagated from seeds, which should be imported or by division of suckers at potting time.

* *C. Drudei* grows about a metre high leaves 45 to 75 cms. Palmately 3 lobed, lobes plaited, deeply and irregularly cut at apex and is probably the most showy species.

C. palmata (*cardulovica palmata*) is a noble species for table decoration when young. It is an ornament to the conservatory. The leaves are very large, the petioles measuring $\frac{1}{2}$ to 1 meter long, the blade being four-lobed and cut into narrow segments; the leaves are gracefully spreading and drooping at the margins. It is out of this plant, that the famous Panama hats are made.

C. bipartitus is an effective and singular plant, 1 to $1\frac{1}{2}$ metres high. The leaf-blades are deep green, about $\frac{3}{4}$ metre long and 40 cms. broad borne on long petioles, and deeply cleft into two broad segments.

C. costatus grows about 1 metre high. The leaves are deep green, $\frac{1}{2}$ to $\frac{3}{4}$ meter long by 30 cms. broad. When young the leaves are not cleft but they ultimately become bifid at the apex. The leaf-stalks are broad and sheathing at the base as in the above species. Native of Columbia.

Cyperus. (*Cyperaceae*): Plants closely allied to grasses, with a number of sedge-like stems rising from the base. They thrive in damp soil and are usually planted by the margins of water gardens. *Cyperus papyrus* is a large plant, about a metre high. It is of great interest as one of the early forms of paper. Propagated by division of suckers or by seed. Only the following species are fitted for cultivation in gardens:—

C. alternifolius, popularly known as the Umbrella Plant or Palm, is a rush-like perennial herb, $\frac{3}{4}$ meter high, with a compact habit of growth, with numerous, erect, dark green, jointless, angular stems supporting a quantity of long narrow leaves, arranged in an umbrella-like manner. Can be grown in large pots in a compost of loam, sand and leaf-mould in equal proportions; a little peat may be added with advantage to the compost. Plenty of water is essential. Native of Madagascar. Useful for general decorative purposes as it

has a graceful habit. Whorls of leaves root in sand. The variegated variety should be propagated only by division; or variegation is lost.

C. elegans is a pretty dwarf form of the above.

* *C. alternifolius variegatus* is very similar to the above but it has the leaves and the stems elegantly streaked with white. The plant grows $\frac{1}{4}$ to $\frac{1}{2}$ metre high and makes an excellent ornamental pot plant, very useful for table decoration. The stem with the leaves is useful for cutting. Reverts to the ordinary species in rich soil losing its variegation.

Diannella nemorosa variegated (Liliaceae). Herbaceous, fibrous rooted perennial. Two ranked grass like long leaves striped yellow or cream. Propagation by division.

Dieffenbachia. (Araccae): Dumb Canes. Called after J. F. Dieffenbach, a German botanist, 1794-1847. Dieffenbachias are noble, evergreen, erect growing aroids, with very striking, handsome foliage. They are pot plants, and are very useful for decoration of rooms and plant houses. The stems are thick and gouty, becoming crooked and top-heavy when old. All the species have handsome foliage; in many, the leaves are broad and variegated with white and yellow streaks and blotches. The juice of the plants is very acrid and poisonous and consequently no part of the plant should be placed in the mouth; the juice benumbs the tongue and causes much swelling and pain and hence the name Dumb-cane to the family of plants.

Dieffenbachias require a liberal supply of water both from the syringe and the water can. Compost No. 11, in page 126 is best suited for them. Firm potting is necessary. Propagation is from terminal and node cuttings. The stem of old plants is cut up into bits, each bit having a bud in it; the bits are inserted in sand in seed-pans, preferably with the buds pointing upwards and covered up with sand and watered regularly, keeping the soil just moist. In about two months, roots are emitted at the joints and the dormant buds grow into shoots emerging out of the soil. When they are about 5 cms. the cuttings are taken out and separately put into 12.5 cms. pots in light soil, consisting of 2 parts of leaf mould, and 1 part each of red earth and sand. When these pots are filled

with roots, the plants are shifted into larger pots using the compost recommended above. Large leaved kinds may be potted one in each pot. But, more than one plant may be put into a pot if the leaves are small. Flowers should be removed as they appear, as they weaken the plant and make the foliage small in course of time. All the species thrive in shade and semi-shade though some are hardy and stand any amount of neglect. The following species are noteworthy :—

* *D. Bausei*; leaves 30 to 35 cms. long, yellowish in colour, margined and irregularly blotched with dark green and profusely spotted with white; the petioles are often white in colour.

* *D. Bowmannii*; leaves are large, deep green, blotched with irregular parallel markings of a pretty pea-green. A handsome large leaved species, the leaves often measuring, 30 to 50 cms. long by nearly 30 cms. broad. Native of Brazil.

* *D. Jenmanii*; leaves shining bright green, with the lateral nerves banded milky-white and the surface here and there spotted white. Handsome species, a native of British Guiana.

D. Leopoldii is a very handsome species, a native of South America. The leaves are deep, lustrous, satiny green. The midrib is broad and ivory white and bordered on each side with whitish band.

* *D. magnifica*. A large handsome species, a native of Venezuela. Leaves are 30 to 45 cms. long and 10 to 15 cms. wide. They are shining sombre green, thickly variegated with blotches or pale yellow or white. The stem and leaf-stalks also are variegated.

D. Regina is a very beautiful species; leaves are oblong-elliptic, of a greenish white colour, mottled with blotches of pale green and having a narrow margin and stray streaks of deeper shade.

* *D. Rex* is a vigorous growing species, handsomely marked. The leaves are closely placed upon the stem. The leaves are of deep green colour passing to paler green near the edge of the narrow unequal side. The whole surface of the leaf is thickly covered with white blotches to within 2 cms. of the margin.

Prominent among other species grown are :—*D. splendens*; *D. picta*; *D. nobilis*; *D. Chelsoni*; *D. Sanderii*. *D. gigantea*; *D. Rudolf Roers'*, *D. arvidre*; *D. memoria corsii*.

Doryanthes. (*Amaryllideae*): Called the Australian Giant Lily or Spear Lily. A plant with ornamental foliage, long and arching as those of some *Dracaenas*. The flowering is long deferred in this country. Useful for adorning conservatories, if grown in pots. Can be planted out in the ground in shade garden. Propagated by suckers removed from old plants and placed in small pots.

D. excelsa is a handsome subject for the lawn in cool localities. The flowers are numerous, brilliant scarlet and are of the size of lilies.

D. palmerri growing $1\frac{1}{2}$ to 2 metres high is also good for lawn planting. Flowers are reddish and funnel-shaped.

Dracaena and Cordyline. (*Liliaceae*): *Cordylines* are very much allied to and are often called *Dracaenas* and *vice versa*. They are very useful ornamental plants of great beauty with symmetrical foliage, which is richly coloured and prettily variegated in several species. There are several varieties, a hundred or more; some of them do well in borders and shrubberies and beds in shade gardens; others make excellent pot plants, serving as useful adornments of the conservatory. Most species are, when young, well suited for table decoration.

Dracaenas thrive in rich loam containing some lime. The compost for *Dracaena* is made up of 3 parts of horse manure, 1 part of leaf mould, 2 parts of red earth and 1 part of sand, with a little addition of lime rubbish for augmentation of the colours. Undersized pots, firm potting, plenty of light (not direct sun), regular supply of water, perfect drainage, occasional spraying with clear water and a cool atmosphere ensure elegant-looking plants. When the plants become leggy as they become old losing the bottom leaves, they may be cut back to a few cms. above the soil and top-dressed with rich compost for bushy plants with fresh foliage. If the plants are too overcrowded or are so staged that the leaves come in contact with rough surfaces, they are injured. Scales, mealy bugs and thrips are some of the common enemies, which can be easily overcome.

Dracaenas are propagated by division of suckers, which

are produced freely in several species, by node and terminal cuttings of the stem and by gooty-layering. Old leggy plants may be cut down to encourage fresh growths which soon come up from the old stem. The shoots cut away may be utilised for making new plants. The mature shoots are cut up into bits 3 to 5 cms. long, each bit having a node or joint in it. These are placed in sand horizontally with the dormant buds pointing upwards in seed-pans and regularly watered, just keeping the soil moist. From the nodes, young shoots soon come up and grow. Each of these bits with the roots as little disturbed as possible, is potted separately, in 15 cms. pots in a light compost but the potting should be firm. Terminal cuttings also strike roots soon but they do not make as satisfactory plants as those got in the above said manner by node cuttings. Plants got from terminal cuttings are apt to lose their lower leaves, if they are carelessly potted or if they do not establish soon.

The following species are useful for planting in a semi-shady border; in their young stage, however, they are beautiful as pot plants:—

D. fragrans is picturesque, tall growing, 2 to 4 metres high; leaves are long, green, lanceolate and very gracefully recurved; flowers are fragrant. Suitable for planting in the shrubbery.

D. fragrans var. *Lindeni* is also tall growing, is very much like the preceding species in habit of growth but the leaves are traversed by a creamy yellow band along the middle throughout the entire length. Very often, only the top-most leaves develop colour. If the plant is cut back and heavily manured, the new shoots that come up generally put on very bright colour, very similar to *D. Victoria*.

D. marginata. The trunk is about 2½ cms. thick, and 1 metre high and branched. Leaves are ensiform, densely rosulate, 30 to 40 cms. long and 3 cms. broad, spreading, rigid-green margined and veined with red.

D. (Pleomele) reflexa and *D. Surculosa maculata* are others.

The following are eminently suited for pot culture:—

* *D. albo striata* = *D. argenteo striata*. Tall and erect growing, very pretty with pale green recurving leaves with bands of white.

* *D. Bausei*: Of striking habit and free growth; leaves

are, about 10 cms. wide, highly coloured, being dark bronze, margined with crimson.

**D. Deremensis Bausei*. A sport from *D. albo striata*. A strikingly beautiful plant, erect growing, being clothed with foliage from base to top, consisting of recurved dark green leaves with handsome bright band of pure white running along the entire length.

**D. fragrans var. Victoriae* is a very handsome species; grows 1½ to 3 metres clothed with leaves from top to bottom which are broad, striped green on bright yellow background.

**D. Goldieana* is a magnificent ornamental plant of erect habit with closely set, stalked, spreading, cordate-ovate-acuminate leaves, with yellowish green background, marbled and blotched with dark green and silver grey. Requires hot and moist climate.

**D. Sanderiana* is a very showy species, the leaves being white and green, suggesting *Arundo donax variegata*. The stems are cane-like and produced freely from the base, forming a clump. Loves semi-shade and frequent topdressing with manure mixed with fresh soil. Difficult to grow at medium elevations. Requires moist hot climate. It does not like to be shifted or repotted frequently.

**D. umbraculifera* is a peculiar and distinct species. Leaves are ½ to 2 metres long and 1.5 to 2.5 cms. wide, dark green, closely set horizontal, with ends gracefully drooping down, giving the appearance of an umbrella. Very valuable as a single specimen in a large pot.

D. ferrea rosea. Leaves 22 to 30 cms. long and 10 cms. wide and ovate-oblong in shape; both the surfaces are deep purplish red which makes the plant very striking and ornamental.

D. gracilis. An elegant species with slender stem and leaves, almost standing horizontally, about 2.5 cms. broad and 30 cms. long, tapering to a point and bright dark green in colour and the margins bordered with dark purple bronze.

D. thalioides is a bushy peculiar species, with green arching leaves.

**D. (Pleomele) reflexa variegata* is a very handsome form of *D. reflexa* with leaves green beautifully banded and broadly edged with yellow, called 'Song of India'.

* *D. Norwoodiense* has very handsome foliage of broad leaves, which are light green with streaks of rose, white and purple.

D. Godseffiana has elliptic green spotted leaves, spotted cream. Grows like a scandent shrub. Requires a moist and hot climate.

* *D. Draco*. Very handsome symmetrical plant with thick stem and long greenish foliage gracefully arching down. Becomes a hanging plant in course of time called Dragon-Tree.

D. albicans; *D. Baptistii*; *D. metallica*; *D. nigro rubra*; *D. Jamesii*; *D. Robinsoniana*; * *D. The Queen*; *D. Warrenii*; are among other attractive species.

Cordyline indivisa is arborescent, very slow growing; 2½ to 4 metres high; leaves are dark green, densely crowded, ½ to 1 metre long and 7.5 to 10 cms. broad in the middle. Small plants are very graceful and useful for table decoration.

* *Cordyline indivisa Veitchii* is similar to the above but the leaves are sheathing at the base and have the mid-rib of a beautiful deep red colour. Very desirable plant. * *C. rubra*, *C. australis* and *C. terminalis*, are other desirable species.

From seeds collected from attractive brightly coloured varieties in the garden, new varieties are obtained. There are several unnamed very desirable varieties in existence. They are very colourful, showy and elegant.

Echeveria. See under Succulents, Chapter XXIV,

Fittonia. (*Acanthaceae*): Fittonias are dwarf evergreen plants with trailing habit. They have very pretty, variegated ornamental leaves, with pink and white veins. They are admirably suited for rockeries in shade and hanging baskets. The larger kinds may be grown in pots and trained against some support like a small ballon. The plants are at their best during the rains. They strike roots at the nodes, which come in contact with moist soil; thrive in Compost No. 9 on page 126. Require a shady situation and plenty of water. Propagated by division or by cuttings. The following species are worth mentioning:—

F. Verschaffeltii argyroneura: A native of Peru. A very neat, compact growing plant, 10 to 15 cms. high, with broad,

flat oval leaves of vivid green, traversed with a net-work of silvery white veins. A truly beautiful trailer. *F. rubrovenosa* is similar to the above, with larger leaves with red veins.

F. gigantea. 30 to 45 cms. high; leaves, purplish, with net-work of pink veins; has an erect, branching, sub-shrubby habit. A native of Ecuador.

F. Verschaffeltii. About 20 cms. high; leaves are purplish with pink veins. A native of Brazil.

Heliconia. See Chapter XXVI.

Hoffmannia. (Syn. *Higginsia*). (*Rubiaceae*). Tropical American, handsome leaved, woody shrubs, $\frac{1}{2}$ to $\frac{3}{4}$ metre high, grown in conservatories in pots. They are shade-loving plants, thriving in rich open soil, containing a little lime, which augments the colouring of the foliage. Propagated by cuttings in sand under glass or frame in the rainy season. Old plants should be cut back to 15 cms. from the surface of the soil for bushy specimens.

* *H. Ghiesbreghtii* (Syn. *Camphylobotrys Ghiesbreghtii*) grows $\frac{1}{2}$ to $\frac{3}{4}$ metre. The stem is woody and four angled. The leaves are broadly lanceolate, pointed and entire, 7.5 to 12 cms. long and 5 to 7.5 cms. broad, with prominent veins, dark velvety green above and purple-red below. A handsome foliage plant for pot culture. Its *variety variegata* is similar to the above but is of a more delicate growth; the leaves have white variegation.

* *H. refulgens* grows 30 to 60 cms.; has deep bronze leaves, which are smaller than in the above species.

H. discolor; 15 to 30 cms. high; leaves, bronzy satiny green.

Homalomena. = *Homalonema* (*Araceae*): Aglaonema-like plants. *H. picturata*, about 30 cms. high, with variegated leaves. *H. Wallisii*, also about 30 cms. high with thick leaves, variegated green and grey. Grown like Aglaonemas.

* **Isolepsis gracilis.** (*Cyperaceae*): A favourite hardy marsh or aquatic grass-like plant, 7.5 to 15 cms. high, with pendulous filiform leaves, 15 to 22 cms. long. Useful for edging in shade gardens. Increased by division.

Ledenbergia rosea. (*Phytolaccaceae*). Ornamental leaved foliage plant, $\frac{1}{2}$ to $\frac{3}{4}$ metre high, with large ovate-lanceolate leaves, dark shining copper green above and bright violet-rosy colour underneath. The stem and branches are rosy-purple. The flowers, though they are not much, are suspended from long filament-like slender threads and are interesting. Propagated by cuttings. Thrives in a compost of rich loam and leaf mould and old manure in equal parts. Requires effective drainage and plenty of pot room. Native of Central America.

Leea amabilis variety splendens. (*Ampelideae*). An improved variety of *Leea amabilis*, 1 metre high, useful for pot culture. Ornamental striking pinnate leaves, bronzy green with creamy white or pink along the mid-rib. Grown from cuttings or seed.

Miconia. (Syn. *Cyanophyllum*). (*Melastomaceae*). Tropical American genus of shrubs with striking foliage. They are valuable subjects for pots for conservatories. Some of the species may also be effectively planted in the ground in shade gardens. Abundance of water, fibrous open soil, and shade are necessary for success in growing them.

* *M. Hookeriana* is a grand ornamental plant, $\frac{1}{2}$ to $\frac{3}{4}$ metre high, suitable for planting in the ground in the shade garden or in pots in conservatories. The leaves are dark green above, with silvery lines running from base to apex, and reddish purple below. A compost consisting of equal parts of leaf mould, sand, and loam with a little peat added gives best results. Regular and careful watering is necessary to keep the plants in good condition. Propagated by seeds or by cuttings, with bottom heat or by layering.

* *M. magnifica* is only $\frac{3}{4}$ to 1 metre high, though it probably grows into a small tree in its habitat. It is a striking foliage plant of great beauty, with very large, broadly ovate, opposite, pointed, prominently veined leaves, which are nearly $\frac{1}{2}$ metre long by 30 cms. broad. They are of a rich velvety green above, with ivory-white mid-rib and nerves running from base to apex and reddish purple below. Cultivated and propagated as the proceeding species. Does well at medium elevations.

M. flammea grows $\frac{1}{2}$ to 3 metres high and has large green rugose leaves.

Musa. (*Musaceae*) : Musas are herbaceous trees, of noble appearance with erect pseudo stems made up of sheathing bases of the leaf-stalks, grown for their fruits, fibre or foliage. They are bulbous and have perennial root stocks. Leaves are gigantic, entire, oblong or elliptic with parallel veins. Flowers are produced in terminal clusters in a conical spike, each cluster being subtended by a large spathe-like coloured bract. In several species as the Plantain, the plant dies after flowering or fruiting and its place is taken up by suckers that come up from below. The common banana or plantain species are valued for their fruits and grown in fruit gardens. They are also, to a certain extent ornamental in appearance but they deserve only a secondary consideration in ornamental gardening. All the Musas are mainly propagated by suckers, though some are raised by seeds. They require copious supplies of water, shelter from wind, and deep loamy soil. Of the more decorative species, the following deserve particular mention :—

Musa coccinea. Height, 1-1½ metres ; leaves, about ¾ metre long, 15 cms. broad and bright dark green. Inflorescence, about 30 cms. long and furnished with spathes of brilliant scarlet, tipped with yellow. Flowers at various seasons throughout the year. A very ornamental plant, propagated by seed or suckers.

* *Musa Ensete*, called the Abyssinian Banana, its habitat being the mountains of Abyssinia, where it grows to nearly 8 metres. But, here, it grows only 3 metres. It is one of the finest decorative bananas, with very long bright green leaves, with crimson mid-rib. The pseudo stem is very thick. The plant yields a very good fibre. Propagated by seeds sown in hot beds.

* *Musa superba* grows about 2½ metres high and a very handsome with its broad, large leaves, symmetrically placed round its thick pseudo stem. It grows wild in the Western Ghats, where during the rains, it beautifully adorns the hill sides with its magnificent foliage. The inflorescence resembles a big purplish red globe suspended from a gracefully bent bracket. The plant dies after flowering.

Musa zebrina. About 2½ metres. Leaves are dark green with broad blotches of bronze-red and purple, irregularly scattered. The pseudo stem is slender.

Nephtytis picturata. (Araceae) : Tall herb, about $\frac{1}{2}$ metre high, with large leaves, handsomely marked with pale green and dark satiny bands. Propagated by cuttings.

Oxalis hedisaroides (thysoroides) rubra (oxilidaceae) called 'Fire Fern' is a beautiful plant with erect, shrubby, wiry stem and thin leaves fern like, glowing satiny red. Bears bright yellow flowers. Grows 20 to 35 cms.

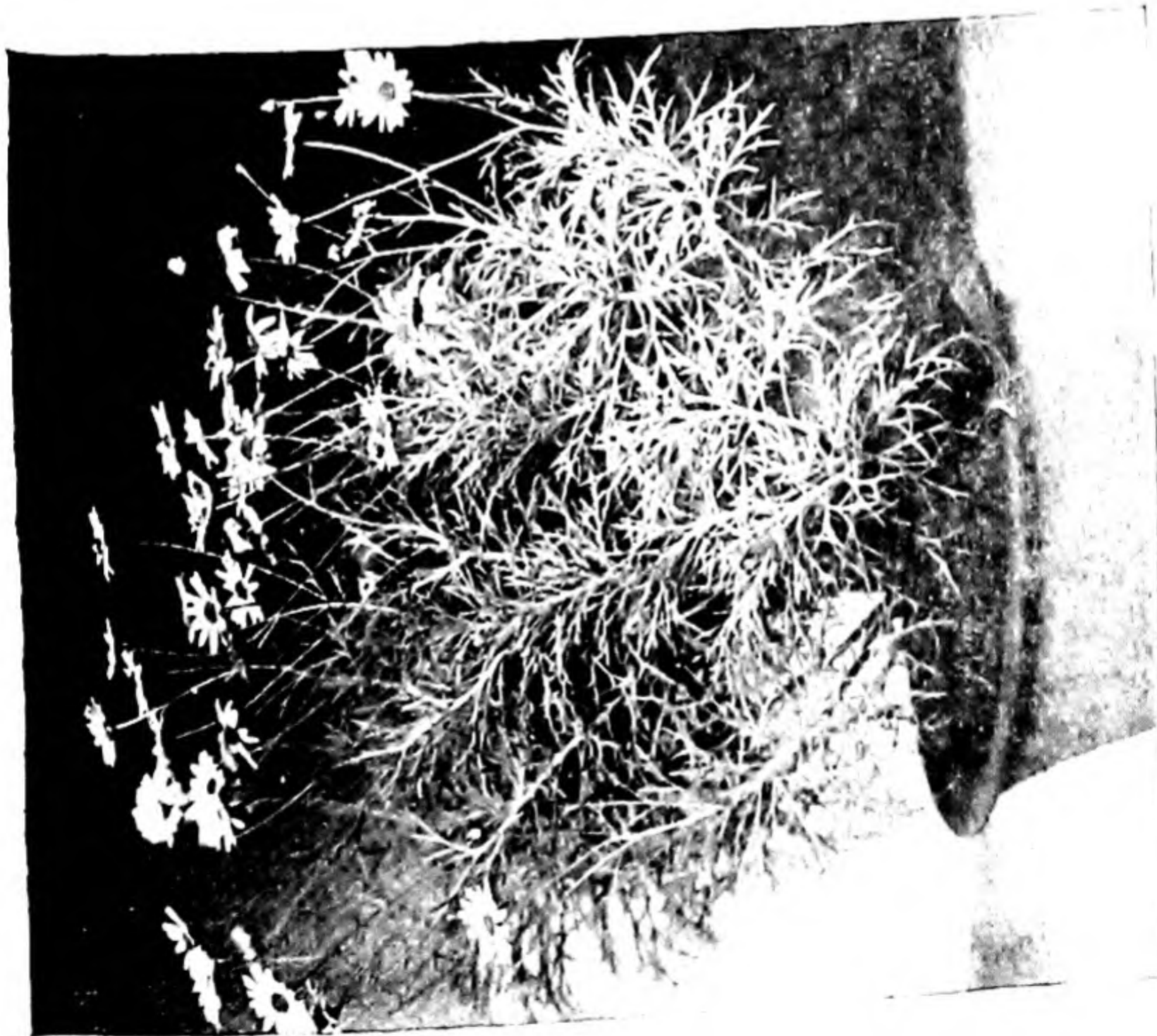
Pandanus. (Pandanaceae) : (Tamil : Thashai ; Canarese : Gedege). Called the Screw Pine. Pandanae are evergreen, mostly thorny, shrubby tropical plants ; some of them are valued for the beauty of their long sword-shaped leaves, which in some species are nicely variegated. The roots are remarkable being mostly aerial and stilt-like. *P. odoratissimus* is the well known 'Thashai', which yields very highly scented flowers, which are sold in the market and are very much liked by Hindu ladies.' It is alleged, that on account of its fine scent, the flower attracts cobras near the bush. A very small type of cobra is alleged to visit the flowers and lie hidden in the inflorescence, so that it is advised that one should not straightaway smell the flower before examining it. The ornamental foliaged kinds are suitable for growing in pots or tubs or on lawns or on the margins of ponds. The variegated species lose their rich colour if the soil is very rich and growth is very vigorous. In poor soil, supplied with just the requisite amount of moisture, they develop good colour. Pot plants should be potted firm and efficient drainage should be furnished. Shading from afternoon sun improves the general appearance of the plants. Propagated by offsets or division of the suckers. Remove a few bottom leaves from the offsets or suckers and pot the cuttings in a mixture of leaf-mould, sand and red earth. For decorative purposes, the following species are recommended:—

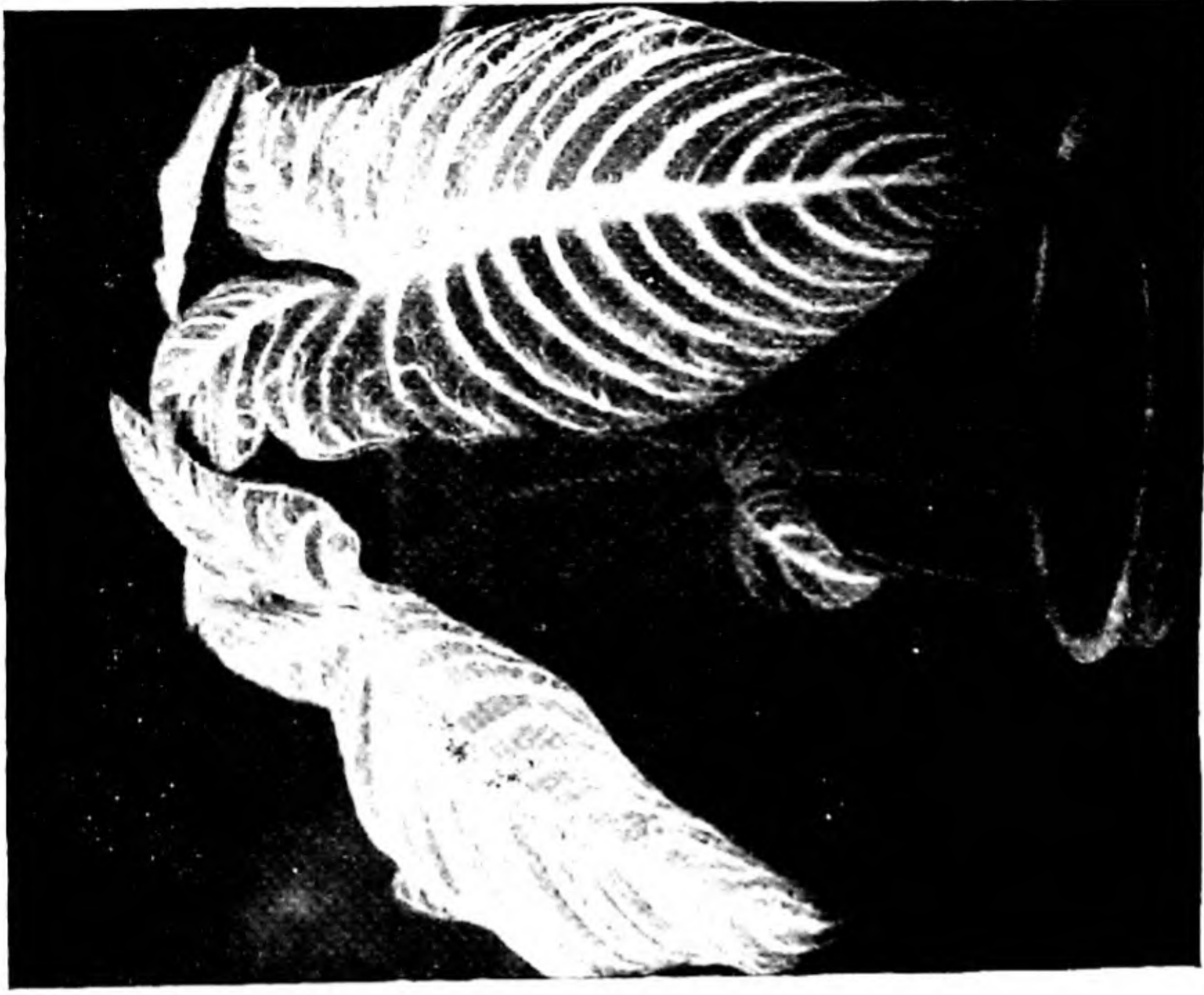
* *P. Veitchii* is a Polynesian ; one the most decorative plants and very useful for room decoration. The broad leaves are often $\frac{1}{2}$ metre in length, somewhat pendulous and slightly spiny. They are pale to dark green in the centre and are margined with clear bands of white, the edges being serrated, which adds to the charm of the plant. If the leaves are occasionally sponged with water, the plant remains fresh and healthy. Grows $\frac{3}{4}$ to $1\frac{1}{2}$ metres.

BEGONIA NELUMBIIFOLIA



CHRYSALEPTERIS BREVIFOLIA





PHYLLOTAENIUM LINDENI



ALCOASIA THIBAUTIANA

* *P. sanderiana* grows $\frac{3}{4}$ to $1\frac{1}{2}$ metres; the leaves are long and arching, $\frac{1}{2}$ to $\frac{3}{4}$ metre long with very minute marginal spines, and are striped creamy yellow, green and white in bands throughout their length.

* *P. graminifolius* is of dwarf growth, $\frac{1}{2}$ to $\frac{3}{4}$ metre high, with branching habit; leaves are narrow and greyish green.

* *P. gracilis* is also a dwarf species with narrow glaucous spiny leaves.

P. Baptistii has broad leaves banded with yellow.

P. variegatus; *P. spiralis* and *P. candelabrum* are some others.

Pellionia. (*Urticeae*): *P. Daveauana* and *P. pulchra* are small trailing fleshy plants, 7.5 to 22.5 cms. high, with variegated leaves, blotched green, grey and violet. The plants are suited for growing in hanging baskets, and also as undergrowths in shade gardens and on rockeries. As they trail along, they emit roots at the nodes coming in contact with the soil. By separating and potting them, the plant may be multiplied. Propagated by cuttings as well. Natives of Cochin China.

Peperomia. (*Piperaceae*): Small ornamental perennial plants with very prettily marked, mostly succulent, cordate leaves, produced in a thick cluster concealing the short rootstock. They thrive only in shady situation in a compost used for ferns. (Compost No. 7, page 127). They do well in pots and are effective on rockery. Easily raised by leaf cuttings or cuttings of stem or by division. Mature but not very ripe leaves are cut with 1.5 cms. of leaf stalk attached to them and inserted in pure sand such that the petioles are well under the soil and the blades are resting on the surface of the sand horizontally. The soil is kept just moist. Soon, roots are emitted and new shoots come up. These are then lifted carefully and potted in small 7.5 cms. pots in light soil. When these are filled with roots and the plants cover the pots well, they are shifted to 15 cms. and finally to 20 cms. pots.

P. argyreia grows 15 to 30 cms. the leaves are oval or round, peltate, variegated, silver striped on green. A very pretty plant, which is easily grown. Native of S. America.

P. metallica grows erect to about 35 cms. with broad

large metallic green leaves, coloured bronze and purple under-side.

P. Fraseri ; *P. magnifica* ; *P. Saundersii* are other attractive species, which are variegated green and white.

Philodendron. (*Araceae*) : Evergreen, dwarf or climbing foliage plants, with green, sheathed, coriaceous, satiny leaves, which are heart or egg or arrow-shaped or oblong. Some species have the leaves, characteristically perforated. Philodendrons make valuable plants for decoration of the conservatory in pots and the climbing species appear to best advantage in shade gardens when they are trained against the bare stem of large trees, pillars, or a back wall. They grow in any good soil and require plenty of water during growth and profit immensely by syringing. They resemble Anthuriums in habit and may be treated like them. Propagated by dividing the stems into lengths, consisting of about three joints and inserting them in pots in sand. The old plants, when they grow unwieldly for the pots, may have their tops cut off and these may be used as large cuttings.

For culture in pots, the following species are suitable :—

P. gloriosum : $\frac{1}{2}$ to $\frac{3}{4}$ metre high ; large, handsome, broadly cordate leaves, with whitish light pink veins, a handsome pot plant. Native of Columbia.

P. Mamei : $\frac{1}{2}$ to $\frac{3}{4}$ metre high, with large, broadly cordate leaves, mottled and blotched with grey.

P. squamiferum has five-lobed leaves of satiny-green colour, shaded with dark green. The petioles are armed with reddish bristles.

P. andrenaum is a climber, $\frac{3}{4}$ to $1\frac{1}{2}$ metres high, with large, beautiful, velvety leaves, resembling those of Anthurium Warocquianum.

P. bipinnatifidum, *P. erubescens*, *P. imbe*, *P. mamei*, *P. pertusum* (*Monstera deliciosa*), *P. pertusum variegata* are also showy species.

Pilea. (*Urticaceae*) : Called the Artillery or Pistol Plants on account of the fact that the pollen are shed out of the flowers forcibly as could be seen by placing a plant that has been just watered on the foliage in the sun. Pileas are small herbs, 10 to 15 cms. high, with graceful fernlike foliage of minute

leaves. They are very easily propagated by cuttings and they grow like weeds and are often self-sown. They serve as moss-like undergrowths under trees in shade gardens and are very effective in pans and in hanging baskets and on rockeries.

* *P. muscosa* = *P. microphylla* is perhaps the best species.

Pilea. *Cadeiri* is a very attractive species with vivid green leaves painted Aluminium.

Phyllotaenium Lindeni. (*Xanthosoma Lindenii*): See under Bulbous plants. Chapter XXVI.

Pitcairnea. (*Bromeliaceae*): Perennial herbs with long and narrow or sword-shaped leaves with prickly margins. Flowers produced in loose sprays. *P. alta*, about 1 metre high, with crimson sprays, is pretty. Both an ornamental foliaged and a flowering plant.

Pothos. See under Climbers, Chapter XX.

Schismatoglottis. (*Araceae*). Dwarf ornamental foliage plants noted for their variegated leaves, which are oblong or heart-shaped, green or striped with silver grey, purple or yellow, and spring from the rhizomes. Shade, moist atmosphere, abundance of water and well drained soil composed of 1 part leaf-mould, 1 part sand, 1 part loam, $\frac{1}{4}$ part charcoal and $\frac{1}{2}$ part peat are necessary. Propagated by division of rhizomes during the rainy season. The following species are recommended:—

S. neoguineensis. 30 cms. Large leaves blotched with yellow. Native of New Guinea.

S. picta. 30 cms.; leaves, cordate-ovate, dark green having feathered greyish band running down the middle. Native of Java.

S. siamensis. 30 cms.; leaves, ovate-acuminate, glossy green, spotted with white. A truly decorative plant, native of Siam.

Schizocasia Portei. (*Syn. Alocasia Portei*). A very large *Alocasia*, 1 to 2 metres high, with very large deeply pinnatifid, sagittate green leaves. Grown and propagated like *Alocasia*, by node cuttings and division of offsets.

Setcreasea purpurea. (*commelinaceae*) also called 'purple Heart' is a creeping plant with striking purple lanceolate feashy leaves. It bears blue flowers.

Strelitzia. (*Musaceae*): Group of ornamental herbaceous perennial foliage and flowering plants with a peculiar fan-shaped arrangement of leaves, which are large and resemble those of the plantain. They require a shady situation, well drained, open gritty soil, and plenty of water. Propagated by seeds or by division. Called the Bird of Paradise Flower.

* *S. augusta* in 1-2½ metres high, with numerous slender stems and banana-like leaves bearing well over the attractive foliage white flowers on a scape. Thrives well in the plains and is quite hardy. Known as "Bird of Paradise Flower."

* *S. regina* is a more delicate plant ¾ to 1 metre high, which succeeds in the plains, only with difficulty. It is very pretty in bloom with its flowers, which have bright orange coloured sepals and deep purple petals.

Both the above species come from South Africa and they may be successfully grown in large pots; they are suitable for planting on lawns too. The latter species requires to be shaded from the afternoon sun.

Tillandsia. (*Bromeliaceae*). Epiphytal perennials, closely allied to Billbergias and resembling them in appearance and character. They are remarkable chiefly for their foliage which is of varied colours: they are grown like Billbergias on logs of wood with moss and kept moist, or in pots. The flowers with coloured bracts are showy in several species. Propagated by offsets. *T. splendens* = *T. zebrina*; *T. Lindenii*; *T. musaica*; and *T. pulchella* are showy species.

Tradescantia. (*Commelinaceae*): Called the Spiderworts. A genus of pretty foliated Mexican herbs of low growth, useful for covering rockeries and for carpet bedding and for growing in hanging baskets.

* *T. zebrina* (*Syn. Zebrina pendula*) has fleshy leaves of a purple colour with greyish streaks on the upper surface. It is a trailer, creeping along the ground and rooting at the nodes. It is known popularly as The Wandering Jew. It is very useful for planting on rockeries and for hanging baskets or for growing in tubs containing other plants for covering the bare surface of the soil.

T. fuscata has long leaves, clothed with dark red hairs. About 15 cms. high.

T. regina is an upright growing species, about 30 cms. high; leaves are mottled white and have a violet centre.

T. zebrina aureo striata has leaves, variegated yellow and white.

T. discolor is a familiar erect growing plant, 30-60 cms. high, with sessile lanceolate leaves of dark verdant green bordered with a thin purplish band and with underside coloured bronzy purple. Grows without difficulty.

Vinca. (*Apocynaceae*). Popularly known as the Periwinkle, *Vinca minor* is a creeping herb with blue flowers. It is best suited for growing on rockeries and in hanging baskets and for covering the ground in shade gardens. It thrives well only at medium to high elevations. The variegated variety, *Vinca minor variegata*, has pretty variegated foliage of small ivy-like leaves. They are striped and blotched with creamy white and green. *Vinca major* is larger than the preceding species in the size of the plant, the foliage and flowers.

Yucca. (*Liliaceae*). Yuccas are bold stiff leaved aloc-like evergreen plants, which are very suitable for planting on lawns and for massing in large gardens. They are very handsome when in bloom with their usually creamy white cup or saucer shaped large flowers which are borne in long erect panicles. Propagated by offsets or seeds or cuttings. * *Yucca gloriosa* is the species most commonly cultivated. It is called the Spanish or Adam's Needle on account of the needle-pointed leaves. It is a large aloc-like plant, about 1½ metre in height, producing a number of side suckers. The leaves are long and flattened. The flower stem starts from the centre of the plant like a column and bears panicles of creamy white, large, cup-shaped pendulous flowers, arranged on it. The plant decked with these delightful flowers is of striking beauty. The flowering period is when the S. W. monsoon sets in.

* *Y. aloifolia* and its variety *variegata* are valuable foliage plants of great beauty with long slender leaves.

CHAPTER XX

CLIMBERS

The word 'Climber' is generally used to include (a) a variety of plants which attach themselves to supports by their rootlets as the Ivy, by hooks as the Bramble, by tendrils as the Sweet Pea and Beaumontia and by other sensitive organs as the stem in Convolvulus and leaves in the Clematis and (b) shrubs which have long scandent branches which require to be fastened to their supports, as for instance the Allamanda. A large number of climbers with varying habits of growth and colours of flowers are available, and properly used, they serve to brighten and cheer up a place. Walls, trellises, arches, pergolas, arbours, pillars or large trees are best adorned by growing climbers against or over them. Some kinds are suitable for growing on lawns, supported by large balloons of iron, for effective display. Many light kinds and annual climbers can be grown in pots furnished with balloons or other suitable framework.

Climbers may generally be grouped under two heads for purposes of convenience:—(a) The heavy climbers which require a strong support as an arch, pergola, or a pillar or tree and (b) The light climbers which are best suited for growing against wire netting or jeffrey work and the like or over plant houses. Again, some kinds are grown only for their handsome foliage. These generally thrive best in shady and semi-shady situations. Others are grown for their flowers. These do best generally in positions fully exposed to sun.

Failures in growing climbers may be traceable to general neglect in preparing pits for planting them and in watering and manuring, as also to want of proper training at the initial stages of their growth and to unsuitable positions given to them. Large climbers should have at least one cubic metre of space for their roots to spread. They should be planted in well drained pits made several days before planting and filled with rich suitable soil. The best time for planting is at the commencement of the rains. During the period of active and

vigorous growth, the plants should be liberally watered. Climbers over a pergola or an arch should have 1 or 2 leaders taken up to form a growth on the top as is required and some shoots should be trained horizontally to cover the lower portions of the frame work. In the case of climbers which are used to cover a trellis, the plants should be induced to branch up from the base to prevent the shoots from running up leaving the basal portions of the trellis bare. For this purpose, when a shoot grows about 30 cms. high, it is pinched back to form two or three shoots, which should be trained horizontally against the trellis wire. This induces formation of shoots from every node of the shoot and these are taken up and trained against other parts of the trellis and so on till the entire frame work is covered up. After all the available area is covered, it only remains to prune away the dried branches and twigs, in the generality of cases. Unnecessary suckers from the base, which thrive at the expense of the plant should be removed every now and then. Climbing shrubs should be pruned with due regard to their habits of flowering. See Chapter X, for hints on pruning shrubs.

Iron or metal supports are very desirable on account of their permanent character. They should be painted with tar or green paint to prevent them from rusting. It is best they are then covered with raffia or tape or some such material till the creeper grows and spreads over the support and protects the tender stems from getting injured by the heat of the sun, by its own shade. For growing against walls, the shoots of the climbers should be fastened to nails driven into the walls, with shreds of cloth in between the head of the nail and the wall so that the wall may not be damaged very much; or patent nails with metal clasps may be used with advantage.

There are several annual climbers of merit which are very useful, either for pot culture on balloons or for growing in hanging baskets or for covering jeffrey work or wire netting. Among the noteworthy ones are *Ipomoea rubrocoerulea*, *Ipomoea Daphnensis*, *Convolvulus* varieties, *Scarlett O'Hara* and *Heavenly Blue*. *Mina lobata* (*Ipomoea versicolor*), *Maurandia Barclayana*, *Cobaea scandens*, *Nasturtium canariensis*, and *Thunbergia alata* (The Black-eyed Susan).

The following are select climbers:—

* **Adenocalymna.** (*Bignoniaceae*): *A. calycina*. Evergreen slender-stemmed, but nevertheless heavy-tendrilled climber with trifoliate and conjugate leaves, bearing yellow trumpet-shaped, Bignonia-like flowers in sprays, a single flower at a time, and extending over several months from March to November. Propagated by layering. Native of Brazil. *A. nitida* is also yellow flowered. *A. alliceae* is lavender flowered.

Allamanda. (*Apocynaceae*): See page 273. *A. grandiflora* and *A. Aubletii* are particularly recommended. They are beautiful evergreen shrubby climbers with large pale yellow flowers, borne throughout the year. They are easy to grow, very attractive, trained against pillars, arches, or over other strong supports. Should be pruned every year to about a joint or two of old wood for large number of blooms. Propagated by layering and by cuttings. Natives of Tropical America.

Antigonon. (*Polygonaceae*): Elegant, handsome, deciduous, tuberous rooted climbers of moderate growth. Flowers are very attractive, being borne freely in large racemes of white, pink and rose shades. About November, foliage loses its lustre and begins to fall. Withhold water and cut down the stem in February–March. Manure and begin watering again. The plants will be in full leaf by June or July. Antigonons are easy of culture and are suited for arches, arbours, verandahs, screens, etc., and they provide cut flowers almost throughout the year. They thrive in deep, rich, well drained soil. Propagated by seeds, by layering and by cuttings. The following species are noteworthy:—

* *A. amabilis* (lovely): Exceedingly attractive and effective species. Flowers, delicate rose or white, borne in axillary and terminal racemes.

* *A. leptopus*: The common but lovely slender stemmed creeper, producing innumerable sprays of beautiful rose-pink flowers in the rainy season and almost throughout the cold season. A variety of the above, *alba* with white flowers, is also handsome. Native of Brazil.

* *A. insigne* (remarkable): Similar to the preceding

species, but is of less extensive growth and bears rose coloured large double-looking attractive flowers. Native of Columbia.

A. Apcari is a new introduction with carmine red flowers.

Argyreia campanulata = *A. splendens*. See under *Ipomoea carnea*.

Aristolochia. (Aristolochiaceae): The 'Birth-wort', 'Dutchman's Pipe'—Hardy, evergreen and deciduous class. of climbing plants, with very peculiar 'Duck-shaped' flowers, which by their bad smell attract flies for pollination. Once the flies enter the flower, they are prevented from coming out immediately until the work of pollination is completed by the peculiar curvature of the flower and the hairs in its throat. Aristolochias are quick growing and do not usually flower till a good height has been reached. Though the plants are good looking, it is advisable to keep them at a distance, on account of their nauseous odour. Propagated by seed, or by layering, or by cuttings taken off with a heel and put in a propagating frame. The following species are recommended:—

* *A. Bonplandii*. Brown flowers, which are spotted and have the appearance of a duck. Leaves are large.

A. Duchartrei: Large shining leaves, 10 to 12.5 cms. broad; flowers, borne in almost sessile racemes from old wood. Flowers have a brown tube and a limb of cream colour with purple blotches.

* *A. elegans*: A slender climber, the best for private gardens as it is very free blooming and the flowers are free from the nasty smell of other species. Flowers are saucer-shaped, nearly 7.5 cms. across are mottled deep purple and creamy white. Propagated by seeds. Native of Brazil.

A. gigas ("Fly Catcher"; "Pelican Flower"). A remarkable plant and the largest flowering species. Flowers are very offensive in smell, rich brown and mottled and much inflated and with tails nearly 50 to 60 cms. long. A native of Guatemala.

* *A. leuconeura*: Leaves are cordate-acuminate and handsomely variegated with yellowish white veins. Purple-brown flowers are borne on the stalk of the main stem, which is quite woody and five or more cms. in diameter.

Asparagus. (Liliaceae) : See page 337. *Asparagus plumosus* with its slender stems and very finely divided foliage which look like being pressed flat artificially is used for trellis on verandah, and other shady situations.

* **Banisteria laurifolia.** (Malpighiaceae) : Choice climbing shrub with dark, olive green, rigid leaves, very ornamental when in bloom from January to April, when it is densely covered with large, compact sprays of bright golden-yellow flowers, resembling those of the orchid, *Oncidium*. Propagated by layering. Known as the *Oncidium Climber*.

* **Beaumontia grandiflora.** (Apocynaceae) : Very ornamental, strong and rapid growing climber, with a strong and woody stem, attaching itself firmly to anything with strong rope-like tendrils, and reaching to the height of a big tree in less than two years. The foliage is very dense and consists of shining, smooth, broad, oblong-ovate leaves, measuring about 22.5 cms. by 10 cms. Flowers are large and trumpet-formed, resembling white Lilies and possessing a faint lily-like smell. They are 10 cms. long by 7.5 cms. across and are borne on large corymbs, covering the plant in a mass of bloom from January to March. Thrives in any rich, well-drained soil, which is well watered, and likes a sunny situation. It is exceedingly well suited for large arches over carriage drives or for growing on large trees like *Bombax malabaricum*. Cut back the shoots after flowering, as flowers are produced on growths of the current season. Propagated by cuttings or by layering. Called the "Nepal Trumpet Flower". A native of India.

* *B. Jerdoniana* is a smaller climber, though heavy.

Bignonia. (Bignoniaceae) : Large genus of scandent shrubs and climbers furnished with tendrils. The flowers are axillary and usually paniced. They are tubular, expanding at the mouth into 5 lobes. The class, as a whole, is suited for plant houses, tennis-court screens, etc. as almost all of them are light, free growers, having a good covering capacity. Propagated by cuttings or layers or seeds. The following species are noteworthy :—

* *B. Chamberlaynii* is extremely spreading, covering a large space of trellis or wall in a short time; the green stem or shoots are several feet long, bearing pinnate, shining leaves.

Flowers are borne in profusion from the axils of leaves almost throughout the year. They are pale yellow, thimble-formed, with a tube about 5 cms long, and contrast well with the rich, verdant, graceful foliage. Native of Brazil.

* *B. cherere*: Bunches of orange-red flowers, with yellow throat, nearly 5 cms. long. Blooming period is between February and May. Leaves are small.

* *B. gracilis*. Beautiful choice climber, exceedingly spreading, attaching itself to the supports strongly by its hooked tendrils. It is the best creeper for covering plant houses, as it is particularly light and has rich, bright, varnished green foliage. Flowers are borne very profusely once a year about March. When in bloom, the creeper is amazingly beautiful forming long festoons of richly coloured yellow, trumpet-shaped flowers, with no leaves to mar the effect. Native of South America.

The climber covers walls without artificial support. It should be planted in deep holes filled with good rich soil and particularly protected from attacks of termites and bandicoots while still young. The plant requires little attention after establishing.

* *B. (Pyrostegia) venusta*: Called the "Golden Shower", "Orange Bignonia". Rapid growing, tendrilled, gorgeous, rather heavy climber, bearing very freely from the axils of leaves, large attractive clusters of crowded, finger-like, tubular, bright orange flowers about 5 cms. long. It is of unrivalled beauty in dry weather, the entire spread of the creeper being one mass of colour. Little care is required after it establishes itself well. It blooms more profusely at medium than at low elevations. Native of South America.

* *B. purpurea* is an evergreen ideal glabrous climber with slender stem for a small garden, bearing in great profusion, deep mauve purple, scented flowers, several times a year.

* *B. magnifica* is a rather heavy and vigorous grower, which is very showy bearing purplish mauve flowers in great profusion in large panicles.

* *B. incarnata (venosa)* bears pale lilac flowers which are striped purple.

* **Bougainvillea.** (*Nyctagineae*): See page 276, under Shrubs. Thrives only at elevations below 1250 metres.

* **Camoensia maxima.** (*Laguminosae*): Strong growing, spectacular heavy climber, bearing very large, scented flowers which are about $22\frac{1}{2}$ cms. long and are white, fringed with yellow. Raised from seed or cuttings. Native of Tropical Africa.

* **Chonemorpha macrophylla.** (*Apocynaceae*): Large, woody, milky climber with stout branches and broadly oval-pointed leaves, nearly 20 by 30 cms. in size. Flowers are Plumeria-like, fragrant, white with yellow centre, about 10 cms. across in expansion and borne freely in the hot season. Thrives with ordinary care and garden treatment. Suited for heavy arches or for growing on trunks of trees like Palms or on pillars.

* **Cissus discolor.** (*Vitaceae*): Also called *Vitis discolor*. Choice, slender, tendril creeper of exquisite beauty, suitable for trellises and for culture in pots over a balloon. Leaves are velvety, oblong-ovate, acuminate, 7.5 to 12.5 cms. long, having the upper surface of a bright velvety green, spotted and mottled with white and red, and an under surface of a deep reddish purple. Tendrils and leaf-stalks and young stems are also deep reddish purple. Flowers are insignificant. The plant requires a deep, porous well drained soil, a shady situation and a moist atmosphere. It is susceptible to root-rot and hence drainage of the soil and watering should be attended to with care. A weak solution of liquid manure of cowdung benefits the plant, if administered once a fortnight. The creeper sheds all its leaves in winter, when it should be cut down to about a foot from the base and watered only sparingly. In March-April, the plant again begins growth after rest, when it may be repotted or top dressed and the supply of water increased as growth progresses. Propagated by cuttings, inserted in pure silver sand. Native of Burma.

C. amazonica is a vigorous climber with large smooth leaves, with silvery veins and red underside. Loves shade.

Clematis. (*Ranunculaceae*): Called popularly the Virgin's Bower. Large genus of beautiful, flowering, useful, evergreen climbers. Flowers have bright coloured calyx and

no corolla. The plants are adapted for many ornamental purposes and can be trained against trellises, walls, and on roofs. They thrive in a deep, rich, loamy soil. As only new shoots produce the sprays of flowers, the climber should be cut back to five buds of current season's growth, after flowering. Propagated by layering, or by inarching on hardier kinds and by seed. Most of the species, especially the large flowering Jackmanii type, flower only in the hill stations. In the plains *C. flammula* and *C. paniculata* grow with ease. For propagation, cuttings should be taken with a good length of stem under the node. *C. triloba* is a common light creeper with jasmine-like flowers.

Clerodendron. (*Verbenaceae*): *C. Thomsonae*, *C. Balfourii* and *C. splendans* are light climbers of small growth bearing carmine with white calyces, red and bright scarlet flowers respectively useful for filling corners and for pot culture.

Clitoria. (*Leguminosae*): *C. ternatea*, called the Butterfly-Pea, is a pretty climber, bearing deep blue or purple or white flowers, single or double. A hardy perennial by nature but raised and grown as an annual from seeds every year. Grown in beds or against small trellis.

Combretum. (*Combretaceae*): *P. grandiflorum* = *Poivrea densiflora*. Heavy creeper requiring strong support. Heavy cheerful foliage. During November to January, masses of dull scarlet brush-like bunches of tiny flowers are borne. Requires to be kept within bounds by purning back after blooms are over. May be grown usefully as a standard.

Congea. (*Verbenaceae*): *C. tomentosa* (*S. phenodesma pentadra*) is a very beautiful, extensive, vigorous climber, very effective with its pale lavender coloured floral bracts in long sprays produced in great profusion. The flowers are insignificant. A sport with white bracts is also commonly grown. May be pruned back severely to bush form. Propagated by cuttings and by layering. A native of Burma.

Cryptostegia. (*Apocynaceae*): *C. grandiflora* is a charming woody climber, overspreading and throwing out very long twig-like stems with deep green leaves, 7.5 to 10 cms. long, borne in pairs. Large bell-shaped bright magenta coloured flowers are borne freely during the hot and rainy

months. Flowers are succeeded by triangular fruits in pairs without stalks and about 12.5 cms. long. Requires a strong support. Propagated by cuttings or layers in the rainy season. A native of tropical Africa. From its milky juice, an inferior rubber is made.

Derris scandens. (*Leguminosae*): A large, heavy, indegenous, climber, very rampant in growth, producing in great profusion, little pale rose, pea-shaped flowers in long sprays. Only suited for large gardens, for heavy pergolas or for growing against large trees. Raised from seed easily.

Echites. (*Apocynaceae*): (Canarese, Tamil and Sanskrit: 'Malati'). Genus of evergreen twining shrubs.

* *Echites caryophyllata*: (Vern: 'Malati') A rampant climber which fastens itself upon and runs up tall trees, producing a great profusion of numberless sprays of its fragrant blossoms, made up of white, star-like, medium-sized flowers with twisted and irregular petals. Flowering period is June to September. Propagated by layering.

* *Echites rubro-venosa*=*Prestonia venosa* (red veined): A handsome plant, suitable for live screens, being a very vigorous grower. Leaves are large, covered with a brilliant net-work of red veins standing out conspicuously from the emerald-green background. Flowers are borne in great abundance are yellow and sweetly scented. Propagated by layers. Both the species are suitable for growing as a large shrub on lawns, kept within bounds by pruning back, or for growing on walls, trunks of trees and banks.

Ficus. (*Urticaceae*): *Ficus repens* is called the Indian Ivy. A beautiful climber, with rich green heart-shaped small leaves. Covers a wall very well by attaching itself firmly to the supports by means of its rootlets, like the Ivy. It is very slow-growing. *F. stipualta* is another desirable species, similar to the preceding, but having larger leaves. It is ideally suited for covering wire-netting screen or a boundary wall. Both the species are best suited for up-country. Propagated by cuttings.

Gloriosa superba. See under Bulbous plants.

Hedera. (*Araliaceae*): *Hedera helix* is the common English Ivy, which does not thrive in the plains but does quite

well at medium to high elevations. A serviceable creeper growing in any kind of soil but requiring shade ; useful for covering walls, open railings, arbour screens. Leaves are thick and polished and dark green. Propagated by cuttings and layering.

* *Hedera helix variegata* is a variety of the Ivy, with leaves, which are lighter in colour and are marked and blotched with creamy-white. Very slow grower. Looks pleasing against an old wall or against a tree. Usefully grown in hanging baskets.

Hiptage madablota. (*Malpighiaceae*): (Sanskrit name : 'Madhavilata'). Indigenous shrub of climbing habit with elliptical-pointed smooth leaves, about 17.5 by 6 cms. Handsome when in bloom in February with its fragrant trusses of flowers, which have each five shortly stalked petals, four of them white and one golden. Easily propagated from seeds, which are produced in plenty or by layering. Grows without care.

Honeysuckle. See under *Lonicera*.

Hoya. (*Asclepiadaceae*): Wax Flower. Several species suited for medium to high elevations. The commonly grown species in India is *H. carnosa*. Foliage consists of thick dark green oval pointed, shining leaves. Wax-like flowers are borne in umbels of delicate flesh colour during the hot and rainy months. Loves shade and good drainage. Suitable for growing in pots over a small bamboo trellis support or a balloon. Useful to cover tree trunks and pillars. Easily propagated by cuttings. Leaves put in sand with stalks down become soon rooted plants.

Ipomoea. (*Convolvulaceae*): The *Convolvulus* family furnishes many handsome light creepers to the garden, bearing beautiful funnel or wheel-shaped flowers of pure white, blue, rose, purple, crimson and intermediate colours. There are many annuals among them, which are raised from seed very easily. The perennials are propagated by cuttings of ripe wood or by division of roots or by seeds. *Ipomoea palmata*, which is well known as the Railway Creeper, *Ipomoea Learii* known as the Blue Morning Glory and others are all of rapid growth with dense foliage and hence are useful

for covering unsightly places by screens in a short time. The following species are recommended :—

I. berauiensis (*Stictocardia berauiensis*) called the 'Candian king' is a fast growing creeper bearing bright scarlet pink flowers with yellow shaning in great profusion. Native of Africa.

* *Ipomoea Bona-nox*. Called "Moon Flower", "Good Night Flower", is a strong climber with woody growth, with cordateovate leaves, bearing white, large, flimsy fragrant flowers, which open in the evening and fade in the morning. Propagated by seed.

* *I. Horsfalliae*; probably a variety of *I. Briggsii*, a very showy evergreen twiner, with handsome foliage of dark green shining digitate leaves and flowers of a deep carmine-red colour produced in plenty almost throughout the year. Excellent for trellis and arches. Propagated by cuttings and by layering.

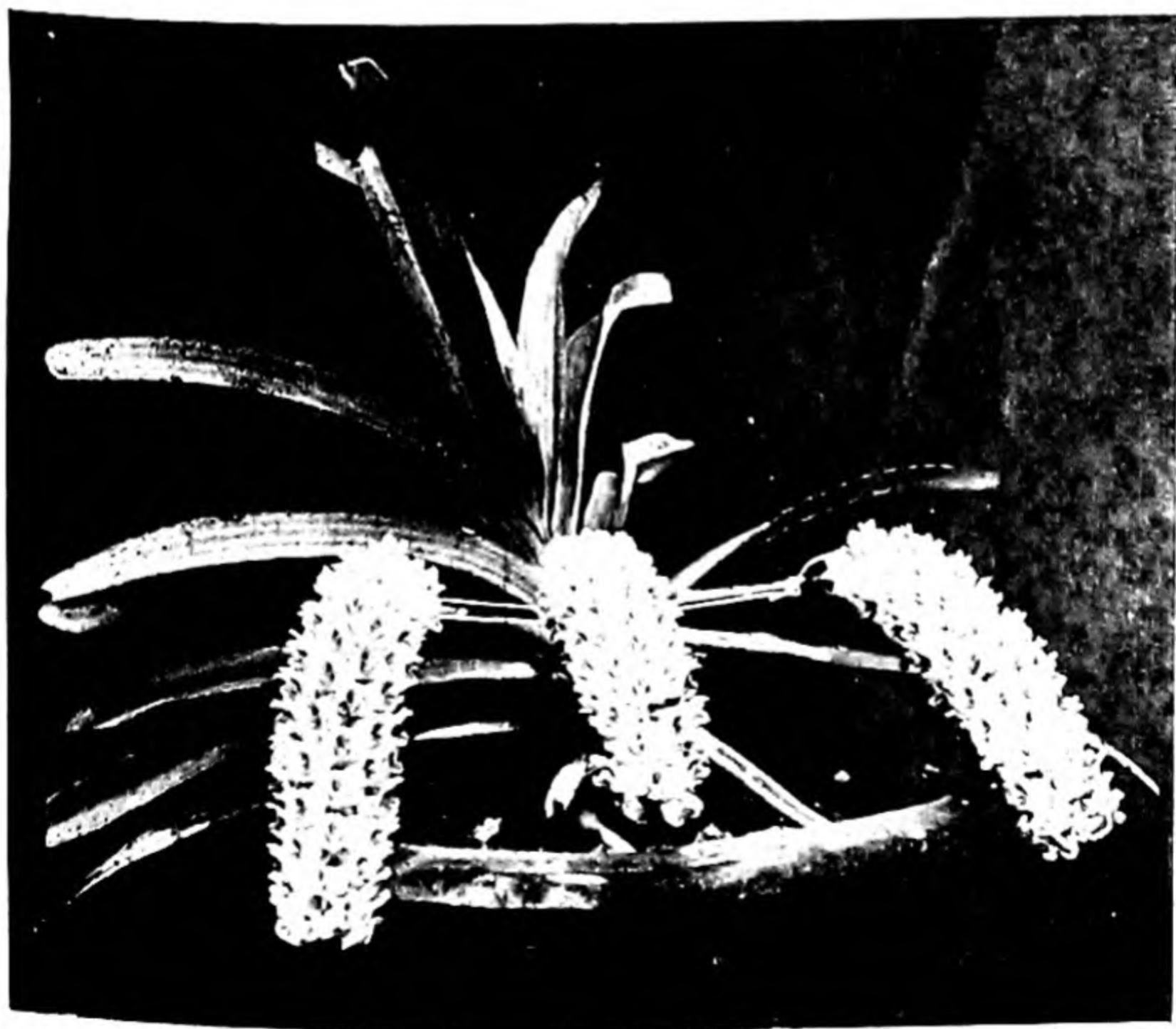
I. carnea = *Argyreia campanulata* is strong growing but it is less of a climber than many of its congeners. Leaves are large, cordate, glabrous and deciduous. Flowers are large, campanulate, rose or pale-pink and profusely borne from July to November. Suited for covering waste places and for planting by compound walls. The plants may be cut down to 15 cms. from the ground after flowering and grown as a scandent shrub. Raised by cuttings.

* *I. pharbitis Learii*, called the Morning Glory or the Blue Dawn Flower, is an old established favourite. It is an evergreen quick grower forming a screen very rapidly. Flowers are dark blue and turn purplish-red as they fade. Continuously in bloom throughout the year, bearing the lovely flowers very freely. To keep the plant in good condition, young shoots coming near the roots should be taken off with some roots attached to them and planted several together in fresh soil once a year, and old plants replaced every year as they become weak. Propagated by division.

I. paniculata (*Batatas paniculata*): An extensive, strong, free growing, tuberous rooted twiner, easy of culture and well suited for trellis work and for covering pillars. It thrives best in rich, open, loamy soil and should not be watered during its



PEPEROMIA ARGYREA



ORCHID, RHYNCHOSTYLIS RETUSA



STEPHANOTIS FLORIBUNDA



DAHLIA, GROWN FOR EXHIBITION

period of rest. Large purple flowers are produced in great profusion in large trusses from June to August and onwards. The leaves are ornamental and finger-formed. Propagated by cuttings.

I. tuberosa (Called the Spanish Arbor Vine). Handsome vigorous grower, bearing large beautiful golden yellow flowers, between July and September. Increased by tubers or seeds.

I. palmata, called the Railway Creeper, bearing purplish flowers, is useful for covering screens, etc. It is very rapid growing and thickly covers large areas in a short time.

* *I. semperflorens* is synonymous with *Jacquemontia violacea*.

* ***Jacquemontia violacea***. (Convolvulaceae) : A small, very free blooming creeper, with neat habit of growth suitable for covering trellises or arbours or for growing in pots or tubs with a balloon-frame work. Leaves are small and cordate. Flowers are small, of the size of a 50 paise piece, bell-shaped, bright blue in colour and borne plentifully in all seasons, and hence called *I. semperflorens*. One of the best tropical climbers, which covers well without rushing to the top quickly. Propagated by cuttings and by layering small terminal cuttings strike root easily.

Jasminum. (Oleaceae) : See page 300. There are some named Jasminums, which are good climbers. They are useful only for their flowers, as there are prettier climbers for use for general purposes in the garden. Of the climbers, *J. grandiflorum* (Canarese and Tamil, ' Jaji ') is the best. It is a large straggling shrub, very pretty with its dark green pinnate leaves. It bears very freely, single flowers with twisted petals, which are pure white above and pinkish red below, in the hot and rainy seasons. *J. officinalis* is another valuable climber bearing white single flowers in terminal clusters. *J. primulinum* bears double yellow flowers. There are other kinds, which are not properly identified and named and which are sold by local nursery men ; they are free bloomers, and are worth growing in gardens for the delicious fragrance of their flowers. Suited for trellis.

* **Lonicera.** (Caprifoliaceae). Popularly called the Honeysuckle. Loniceras are great favourites in many gardens. The tall growing kinds are well suited for covering arbours and small trellises and for covering open railings. All the species are easy to cultivate but it is only *L. japonica* (*chinensis*) that thrives in the plains. It is a light grower, bearing clusters of very fragrant tubular flowers which are white and turn yellowish as they become old. * *L. sempervirens*, known as the Trumpet Honeysuckle bears orange red flowers, which are not scented. Propagated by cuttings of young wood of firm texture and by layering.

Lophospermum scandens = *Maurandia scandens*. (Scrophulariaceae). Handsome herbaceous creeper with heart-shaped leaves and tubular Foxglove-like flowers of a rich pink colour, climbing a large extent of trellis by its leaf stalks. Easily raised from seed. Pretty, grown in large pot over a balloon.

Mandevilla suavelons. (Apocynaceae): Known as the Chilean Jasmine. A slender stemmed creeper bearing pure white fragrant flowers, nearly 7.5 cms. across. Thrives only from medium to high elevations. Propagated from seed and by layering. Suited for covering trellis.

Maurandya. (Scrophulariaceae): *M. Barclayana* is a small herbaceous perennial climber, with slender shoots and small leaves, bearing Snapdragon-like flowers in purple, white, magenta and pink shades. Useful for growing in baskets and over balloons. For *M. scandens*, see under Lophospermum.

Odontadenia speciosa. Syn. *Dipladenia Harissii*. (Apocynaceae): A handsome creeper with large, 12.5 to 15 cms. fresh green leaves, bearing fragrant and showy salmon-yellow flowers in large drooping clusters. Requires semi-shade and would thrive against a porch facing east. As it flowers on wood of current year, it should be pruned back after flowering. Propagated by layering.

Passiflora. (Passifloraceae): Group of well known tendrilled climbers of rapid growth, requiring a strong trellis for support. Flowers are peculiarly shaped and formed, and are interesting and beautiful. For successful culture, Passifloras require a rich open soil, containing a large quantity of lime, and a liberal supply of water. The branches must be cut back

and thinned out every year after flowering as the plants produce flowers on wood of the current season. The blooming period is generally between July and November. As a class, better suited to medium to high elevations. The following species are recommended :—

* *P. coerulea* and its hybrids (the Common Passion Flower) are handsome, slender but strong, vigorous growing climbers with bright three to five-lobed leaves, covering a great space of trellis in a short time. Peculiar purplish blue faintly scented flowers are borne plentifully almost throughout the year. They grow readily from seed and may also be propagated by suckers, which they send out round the spot where they grow.

* *P. kermesina* (Syn. *P. Raddiana*) : A slender stemmed, very beautiful extensive climber, with trilobed, dark green, shining leaves. Flowers are solitary with very narrow distinct sepals and petals of a bright crimson red are freely produced in the hot and rainy months, on long slender branches, which gracefully hang down an arch or tree. Rather a shy bloomer in the plains.

* *P. laurifolia*, called the Jamaica Honeysuckle ; a rampant climber with dense foliage of laurel-like rich green glossy leaves. Flowers are large, sweet scented and violet-purple in colour.

P. quadrangularis, called Granadilla Vine, is a rapid growing extensive climber with four-cornered ligneous stems and large leaves, 12.5 to 15 cms. long. Flowers are fragrant, very large, pinkish variegated with blue. The fruits are very large, looking like cucumbers. The fruits are brownish yellow, have a hard skin and contain a gelatinous pulp and sub-acid juice with a fine flavour. They may be used raw, or boiled and used as vegetable ; when ripe, the pulp and juice can be eaten directly from the fruit by scooping them out with a spoon, after putting some salt or sugar. Propagated by layering or by seed. Suited best for lower elevations. Native of Jamaica.

P. edulis bears much smaller fruits, which are egg-shaped and dull purple in colour. The pulp has a very fine flavour and is eaten directly from the fruit. Sherbets, confectionery

and jams are prepared from the fruit, which is extensively grown in Australia for that purpose. Both the above two species, grow well on trellises and produce two crops a year, if well manured and looked after. Suited for medium elevations.

Pereskia bleo. (Cactaceae): Peculiar large climber with cylindrical stems covered with long needle-like spines and bearing leaves quite unlike other plants of the family. Always in blossom with very pretty pink flowers resembling single pink roses. Propagated by cuttings.

* **Pergularia odoratissima.** (Asclepiadaceae): ('Lavan-galata'). Popularly known as the Cowslip creeper. An elegant light climber having cordate-acuminate, leaves of a dull green colour about 7.5 cms. long and broad. Flowers are greenish yellow and very highly scented and produced freely in bunches, several times a year; but the blooms do not show out at all. Propagated by suckers or by layers. Thrives in a slight shady situation in a rich loamy soil, kept open by broken brick pieces. It is a great favourite in Hindu homes, where the flowers are used for puja and are very much liked by ladies. Picked and arranged in a bowl floating on water, attractive and useful, spreading delicious fragrance in the room.

* **Petrea volubilis.** (Verbenaceae): Scandent or twining lovely plant, requiring a strong support, bearing bright blue and purple star-like flowers in large elegant wreathlike sprays; hence called the Purple Wreath. Racemes of flowers, which are 17.5 to 20 cms. in length crowd the plant, covering it up in a mass of beautiful purple-blue colour, in February and November. Propagated by layering. A very showy plant suitable for planting on lawn, as a large shrub, with a framework to support it.

Philodendron. (Araceae): See page 354. A genus of mostly climbing plants with ornamental heart-shaped large leaves of a metallic lustre, which are often more or less perforated, adhering to trees and walls by their roots. They thrive in rich, loose, well drained, regularly watered soil. Several species are very decorative in pots and almost all of them require to be just shaded from the sun to prevent the foliage from getting scorched.

P. pertusum (perforated) also named, *Monstera deliciosa*, is a heavy root-climber, with very large, perforated, bright polished green, handsome leaves, bearing edible fruits, which have the combined flavour of the banana and the pineapple. The flower is large and peculiar, consisting of a large waxy white boat-shaped spathe which encloses a green spadix. The spadix develops into a large fruit. It measures about 20 cms. in length, is greenish yellow in colour and looks like a conical breadfruit. The fruit begins to ripen from below upwards, when it is picked. It takes a week or more for it to ripen, when the hexagonal scales fall off, and to be ready for use. The plant is useful for covering the bare stems of large trees. It can be grown in large tubs for adornment of conservatory or it can be grown against pillars in shade gardens. Propagated by division of the growing stem into bits, with two to three joints on them, and inserting them in sand like node cuttings.

* **Poivreia coccinea.** (*Combretaceae*): Very much like *Combretum* and called *Combretum coccineum*. One of the most delightful climbers, a handsome ornament of gardens. It is thin-stemmed and has a foliage of luxuriant, dark green, glossy leaves. Small star-shaped flowers are abundantly produced almost always in large, compact, brush-like, flat sprays of a brilliant scarlet colour. Propagated by layering, which usually takes a very long time, or by inarching on vigorous growing species of *Combretum*. Raised from seed also.

Porana. (*Convolvulaceae*): * *Porana paniculata*, popularly known as the Bridal Creeper, because of its snow like masses of tiny flowers. A large climber, with cordate-acuminate grey-green leaves about 7.5 cms. long by 4 cms. broad, producing large sprays composed of small, pure white, funnel-shaped, slightly scented flowers. Flowers twice a year. Very handsome in bloom, especially in December. Propagated by cuttings or by layering. Well suited for covering a wall or trellis as it covers well and seldom gets bare at the base.

* *P. volubilis*, called the "Horse-tail Creeper", "Snow Creeper". Vigorous climber with cordate-acuminate, shining leaves; very handsome while in bloom with dull white flowers

crowded in large dense panicles. Flowers are delicately scented. Raised by cuttings or layering.

Pothos. (*Araceae*): Evergreen climbing, ornamental leaved shrubs of epiphytic growth. Leaves are roundish or lance-shaped, green or variegated with cream yellow. Pothos are grown in conservatories in pots while young or allowed to climb up a pillar or against the trunks of large trees, which they cover handsomely. Syringe the foliage freely all the year round. Treated like Anthuriums. Shade from sun. Propagated from cuttings.

P. argenteus. Beautiful silvery grey leaves with deep green margin and midrib. Climber of dwarf growth.

* *P. aureus.* Large leaves, variegated with yellow. A very handsome extensive climber, growing up large trees.

* **Quisqualis indica.** (*Combretaceae*): Popularly known as the Rangoon Creeper. A scandent, quick-growing, showy climber requiring a large trellis for support. Bears all the year round, in constant succession, numberless, drooping clusters of very pretty flowers, which are pale pink or white when fresh but change to crimson next day, and scented late in the evening. The creeper is very hardy and thrives in any good soil. Easily raised by cuttings or by layers. Not suited for hill stations.

Q. densiflora bears denser bunches of pink changing to scarlet flowers.

* **Rhyncospermum** (*Trachelospermum*) **jasminoides.** (*Apocynaceae*): A choice, slender evergreen climber, with oval, pointed, dark green smooth, leaves, bearing freely in the hot season and at other times of the year, large corymbs, full of pure white, pleasingly fragrant, jasmine-like flowers, nearly 2½ cms. across with twisted corolla. It does well against a trellis or an arch. Grows without much care. Propagated by cuttings or by layering. Should be pruned after flowering.

Roupellia grata. (*Apocynaceae*): A large woody climber or scandent shrub with glossy, bright, elliptical, opposite, entire, large leaves, bearing in the hot season, large terminal clusters of sweet-scented, showy, pale, white flowers shaded purple, nearly 6 cms. across. Propagated by layering or by cuttings with difficulty.

Smilax. (*Liliaceae*): Genus of economic and ornamental creepers. Most of them have prickly stems. Roots of some species, known as Sarasaparilla, are used in medicine and in making cool drinks (syrups). The garden species are trained against sunny walls, arbours, trellises or banks. They thrive in shade and climb against trees; require a loamy, well drained soil. Propagated by division of roots at planting time.

S. argyrea and *S. ornata* are two favoured kinds.

Solandra grandiflora. (*Solanaceae*): A scandent shrub with large leaves and large trumpet-shaped creamy white flowers. Suited for covering trunks of large trees.

Solanum. (*Solanaceae*): Solanums are best suited for upcountry.

S. jasminoides, called the Potato Creeper is a large, shrubby, heavy climber, reaching several feet in height and hence suitable for growing against large trees. Bears small, star-shaped, pretty flowers, which are white and tinted with light blue.

S. jasminoides variety *grandiflorum* bears very large trusses of flowers. Both the above do not thrive in the plains but do well from medium to high elevations.

S. Seaforthianum, called the Blue Potato Creeper, is a slender climber, with much divided leaves and pretty clusters of purplish blue flowers, which are succeeded by crimson berries. May be successfully grown in a pot, furnished with a support.

**S. Wendlandii* called the Potato creeper. A showy vigorous growing climber, with prickly stem and branches and slightly prickly leaves, which are deciduous. Flowers are nearly 5 cms. across, lilac-blue in colour, and are borne for several weeks in large pendulous cymes, which are 45 cms. or more across. Requires severe pruning after flowering. Enjoys full sun-shine. Is moisture loving. For best results, restrict the flowering to only a few leaders, about half a dozen on each plant, which may be cut back 1 to 1½ metres of previous year's growth. Remove all old wood. Propagated by seeds, cuttings or by layering.

Stephanotis floribunda. (*Asclepiadaceae*): Called the Clustered Wax Flower or the Creeping Tube-rose or the Madaga-

scar Jasmine. An evergreen, very popular, choice climber with thick, glossy leaves, bearing freely, sweetly scented, tubulose-like, waxy-white, tubular flowers in large clusters. Does well in a north-east aspect, in rich loamy soil, rendered porous by broken bricks and old mortar or lime. Perfect drainage and regular watering, just keeping the soil moist, are necessary for success. Frequent syringing of the plant does good. For established plants, stimulants may be applied once a month. Straggling shoots should be pruned and weak ones should be thinned out. Suitable for arches or for growing in large pots with balloons. Propagated by layering. Appreciates syringing and moist atmosphere.

Stigmaphyllon aristatum. (*Malpighiaceae*): Choice, small, evergreen, very handsome climber, having glossy leaves and bearing bright yellow flowers, with fringed petals. Suited for small trellis or archway near the house. Thrives in sandy loam containing much humus. Propagated by layering or cuttings.

Strongyleton macrobotrys called the jade plant. A native of pacific Islands. Glabrous twining creeper, leaves pinnately trifoliate with showy red flowers in racemes.

* **Tecoma jasminoides.** (*Bignoniaceae*): Graceful, evergreen climber, with bright, polished, dark green, pinnate leaves, flowering throughout the year. Flowers are very attractive, have a tubular corolla, are white and much expanded and streaked with rose purple in the throat and are clustered in large, compact, terminal bunches. Suited for pillars, archways or for growing in large tubs or pots furnished with suitable framework.

T. Campsis grandiflora bears very large bunches of orange Bignonia-like flowers in the hot months. It is furnished with pretty foliage, which is deciduous in cold weather. Propagated by suckers.

T. rosea produces sprays of pink, trumpet-shaped flowers, which are useful for cutting.

Thunbergia. (*Acanthaceae*): The genus includes a large number of vigorous free flowering climbers. They are useful for growing on porches, arbours, verandahs, old trees, trellises, arches etc., but as a class are subject to bug and scale pests.

Vigorous pruning is harmful and may prevent free production of flowers. The following species are recommended :—

* *T. grandiflora* is a large, extensive, heavy climber with heart-shaped leaves, about 15 cms. long. But it can be kept down within proper limits by judicious training and use of shears. Flowers are large, widely expanded, 7.5 to 9 cms. long and broad, of a pale blue colour; they are solitary or in short stout racemes in leaf axils, borne in all seasons, but principally in the cold season. Thrives in rich stony soil and requires a free supply of water. Suited for trellis of tennis courts. Looks best grown on a large tree where it can freely spread and flowers. Native of Bengal. *T. grandiflora alba* is a white flowered variety of the above.

* *T. mysorensis*. Syn. *Hexacentris mysorensis* is a good climber of good covering capacity, not so heavy as *T. grandiflora*. Leaves are about 15 cms. long, elliptic-acuminate and rounded at the base. Flowers are coloured yellow, red and purple and are borne in chain-like pendulous racemes, gracefully hanging down from the slender shoots, being orchidlike in appearance. An arch or a pendal, covered with this creeper with its drooping long pedicelled racemes, presents an enjoyable sight from January to March. It is known as the Manjarabad Creeper, as it is a native of that taluk in Mysore State. Propagated by layers.

T. coccinea. Syn. *Hexacentris coccinea* is similar to the above but has smaller leaves and bears smaller racemes of red flowers, with yellow throat. Native of Nepal and Khassya mountains.

T. alata includes light creepers of many forms, including the "Black-eyed Susan" which is orange-coloured with dark centre.

T. fragrans is another light creeper with snowy white flowers.

T. Gibsonii bears orange-coloured dazzling flowers. All the above may be treated as cold season annuals in the plain country.

* *Tristellateia australis*. (*Malpighiaceae*): A very, handsome, woody, small climber flowering very freely throughout the year. Flowers are bright yellow, in axillary and terminal racemes. Propagated by seeds or by layering. Can be grown in a large pot, furnished with a balloon.

Vallaris Heynei (*Apocynaceae*): Twining shrub with pretty light green foliage, bearing creamy-white, cup-shaped sweet scented flowers in cymes of about ten flowers, twice or thrice a year. Propagated by suckers, which it produces in plenty or by layering.

Vitis discolor. See *Cissus discolor*.

CHAPTER XXI

PALMS AND CYCADS

PALMS

There are as many as about 150 genera and several hundreds of species of Palms, though the amateur gardener is familiar with only a few which interest him. Palms and their allies form a very extensive group of plants, truly noble and majestic and of tropical grandeur. Excepting one genus which is a native of Europe, they are natives of the Tropics. They have a marked, easily recognisable general appearance. There are wide variations however, in form, size and habit in the several species. Most species have an unbranched, erect, tall, cylindrical or columnar stem, which is called the caudex. In some species, however, as in *Attalea* (*Orbignya*) *Cohune*, the stem is very short and the leaves appear to originate direct from the ground. Others like *Calamus*, have long cane-like slender stems, armed with hook-like spines, enabling them to climb large trees. While in some species the caudex is smooth, it is, in others, marked by scars and depressions left by fallen leaves or their stalks. Leaves also vary much in form and size. Palms are generally grouped under two heads, the fan-leaved and the pinnate or feather-leaved kinds. In the former class to which belong *Chamaecrops* and *Latania*, the chief veins of the leaf-blade appear to rise from the top of the leaf-blade. In the pinnate-leaved section, which includes the *Phoenix* or the *Date Palm*, the chief veins run out of the sides of a long midrib, the leaf being very often divided into long and narrow segments. All Palms are endogens, the stems of which grow by additions developed from the inside, do not increase much in thickness, and do not show any distinction into bark, wood and pith. Flowers are produced in spikes but they are not much, though in some kinds, as in *Caryota urens*, they hang down gracefully, clustered in large trusses.

Palms are of great ornamental value. There are several species suitable for decoration of conservatories, verandahs,

stair-cases, for avenue planting, for decoration of shade gardens etc. Though a majority of Palms attain great heights when planted out they are grown as 'dwarfs' in pots or tubs in restricted root space. On account of their very slow growth, they may be kept in pots remaining in beauty for many years. Certain Palms are of great economic value, some of them affording shelter, food, clothing, fibre, timber, oil, sugar, starch, wax, wine, resin, tannin-dye-stuffs and many other products of great utility. The importance of the Date Family and the Coconut is well known.

Palms are easy to cultivate. They are tropical in nature and thrive in a warm humid atmosphere in light loamy soil containing a large quantity of humus. They grow both in shade and sun and rapidly recover if they have suffered from heat or cold. At medium elevations they are not so rapid in growth as in coastal regions where a salty and warm humid atmosphere prevails. They can be grown under glass in Hill stations. There are very few diseases and pests to which Palms are subject. Scales and mealy bugs are often noticed on the veins of leaves and are often hidden under the bases of leaves clasping the stem. The stem should be kept clean and old leaves and leaf-stalks should be removed carefully without injuring the stem. Parts of the stem infested may be sponged and sprayed with fish oil soap or methylated spirits. Rhinoceros beetle attacks young shoots boring holes and making way for weevils which may kill the plant in course of time. The beetles are best killed by harpooning them with a thick wire thrust into the holes. Caterpillars are often seen attacking foliage of Cycads. Palms should be regularly and liberally supplied with water. Those which suffer by neglect in watering seldom recover.

Palms are propagated from seed. Some kinds as *Rhapis* which produce a number of suckers from the base, are increased by dividing the clumps into several pieces, each having some roots. Propagation of Palms from seed is very slow, taking some years before plants of desirable size are secured. Seeds vary in size from the size of pea to the size of a coconut or larger, in the several species. They are covered with a thick coat which makes germination very slow. They

should be sown in well drained fine soil and covered to the thickness of their diameter. The seedlings should be lifted as soon as the first pair of leaves appear and potted off singly in small pots; the pots chosen should be just sufficient to accommodate the roots and the roots and the fruit with some little soil. Seeds may be sown at any time of the year, but it is best done in Spring. As the plants grow and fill the small pots they are in with roots, they should be shifted to pots of the next larger size, holding about 2.5 cms. more of soil all round the old ball of earth. As Palms emit long roots, the seedlings suffer much if they are not removed early and potted.

A few important points need particular attention in the cultivation of Palms in pots. They prefer to be pot bound and thrive in under-sized pots. They are best allowed to remain in the same pots till the roots increase and fill them, almost to the point of breaking or forcing the pots open. At the time of repotting, the fleshy large roots are best not injured. After removing the crocks at the base, the plants should be repotted with the ball of earth intact, using a pot of the next larger size allowing fresh soil all round to a thickness of about 4 cms. Planting should not be too deep. The collar, that is, the point where the roots emerge from the caudex should just rest on the soil surface. Top dressing once or twice a year is necessary. For the foliage to be maintained fresh and green, the plants need feeding with liquid manure. Oil cake water may be alternated with weak ammonium sulphate solution (15 grams per litre of water) once in fifteen days. Regular supply of water, overhead watering once in two or three days by syringing, good drainage and periodic supply of weak liquid manure conduce to healthy specimens.

The following are the more attractive Palms for the garden :—

Areca. Genus of elegant pinnate-leaved palms, widely distributed over the world. The commonest economic species is *Areca catechu*. The Betel Nut Palm, which is commercially grown. The following are the more ornamental species:—

* *Areca alba* = *Dictyosperma alba* : Native of Mauritius.

Handsome species, very useful for table decoration in the young state. The stem is slender and attains a great height. In the palmery or the fernery it is beautiful only till its stem is 15 to 20 cms. high. Leaves are 10 to 20 cms. in length.

* *Areca lutescens* = *Chrysalidocarpus lutescens* is a native of Madagascar, forming large clumps, 50 to 60 cms. high. A very popular graceful species, with arching leaves; very ornamental in pots or tubs and useful for planting out on lawns or in shade gardens. Propagated by suckers or from seed.

Areca triandra. Native of Assam and Burma. Similar to but prettier than the Betel Nut Palm with wider pinnae.

* *Areca rubra*. *Areca rubra* is synonymous with *Dictyosperma rubra*.

Areca madagascariensis is the same as *Dypsis madagascariensis*.

Arenga. *Arenga saccharifera*, called the Sugar or Sago Palm. A beautiful and magnificent tall species, with enormous shining dark green pinnate leaves, 50 to 60 cms. long with a graceful curve towards the summit, thrown up erect from the sides of the trunk. Effective if planted at the entrance of the garden. Excellent for forming a grand avenue. Native of Moluccas, Java, Sumatra etc. The medulla of the trunk is used as sago and from its juice, an excellent sugar is made. *A. Wightii* is also a beautiful species. Native of Malabar.

Borassus flabelliformis. The common 'Palmyra' is one of the hardiest kinds, but not of much ornamental value in a garden.

Calamus. The Rattan or Cane Palms. Pinnate-leaved. They have rambling a habit to be grown in a garden. But, when too young, some kinds make admirable pot plants. *C. ciliaris* and *C. Roxburghii* are two handsome species recommended.

Calypocalyx spicatus. A nice for pot culture. Has the appearance of *Chamaerops excelsa*. Native of Molluccas.

Caryota. Caryotas are quick growing large palms with large broad leaves, which are finely cut up. The small divisions or the leaflets are delta or fish-tail shaped, and hence Caryotas are popularly called Fish-tail Palms. They are good for avenue purposes. They are striking in bloom, the large flower-spikes very gracefully drooping down from the axils of leaves. Flowering proceeds from top downwards, a spike

issuing out of the axil of each leaf and the plant dying when the lowermost axil is reached. Caryotas yield toddy, hence also called Wine Palms; from the wine a sugar is obtained. Best species are:—

C. sobolifera is an elegant species with slender stem, bipinnate curious leaves and bright light green leaflets. It is a comparatively dwarf species, producing suckers from the base, from which it can be increased.

C. urens. Called the Toddy Palm, Malabar Sago Palm or the Wine Palm. Is the largest species of thea genus, attaining a height of 15 metres or more in its native home, with leaves $4\frac{1}{2}$ by 3 metres, the pinnae being $1\frac{1}{4}$ metre long, curved and drooping. A healthy plant with its long drooping species is a striking object in the garden. Yields an immense quantity of sap (toddy), nearly 100 pints in a day. The pith of the tree is reported to equal the best sago.

* *C. Mitis* produces suckers from the base from which it can be propagated.

Chamaerops. Mostly slow growing plants of medium height, with fan-shaped leaves. Very easily grown and highly ornamental. Propagated from seed and sometimes by suckers. Better suited for medium elevations.

* *C. excelsa*. Plants 1 metre high are very handsome. The large broad fan-shaped leaves are cut up deeply into segments. The leaf-stalks are armed with spines at the edges.

C. Fortunei, a native of S. China.

* *C. humilis* (dwarf) is a very fine species. Produces suckers at the base, which should be removed, if a tall plant is desired. Retains its health for several years without growing large. Native of S. Europe and the only European Palm.

Cocos. Genus of graceful palms, to which the Coconut palm belongs. Most of the species are very tall but some are medium-sized and suited for growing in pots.

C. nucifera is the common Coconut Palm. For ornamental purposes, the King Coconut, with yellow or green fruits, (there are two varieties) is eminently suited. The fruits are borne early; the plants start fruiting when the stem is barely 1 metre high, the long graceful bunches touching the ground.

* *C. plumosa* is an attractive palm, a native of Brazil. In its young state, it is a splendid decorative plant in any situation.

* *C. (Syagrus) Weddelliana* is a very elegant and graceful palm, smaller than the other species. Difficult to grow.

C. Romanzoffiana is very handsome, when young. Fit for ground culture.

Corypha.—Genus of fan-leaved palms, growing to a great height in their native home, but striking when young, with their immense leaves. They are of very slow growth.

C. umbraculifera, called the Talipot Palm, is a native of Ceylon and S. India. Dried leaves are used for making crude umbrellas in Malabar. The large broad leaves are used for thatching.

C. australis is the more desirable species for the garden.

Dictyosperma.—Synonymous with Areca family. *D. alba*. A fine palm; a hardy, strong grower. Makes a good, bold, beautiful, specimen plant.

D. rubra is a handsome species.

Elaeis guineensis.—Economic ground palms, called the African Oil Palms. They are handsome for pot culture too. *Elaeis guineensis* variety *abepa*; *abedam*; *ewakwa*; *Banga*; and *Lisambe* are all desirable kinds.

* **Geonoma gracilis.**—This and the other members of the genus such as *G. Princeps*, *G. Schottiana* are small elegant palms. They are like Kentias and come from Tropical America. Useful for table decoration.

Heterospathe elata.—A fine species, resembling *Cocos* in appearance,

Howea.—Called after Lord Howe's Island, where the two species grow. They are known as Kentia in trade. Very attractive and popular and useful for decorative work.

* *H. Belmorena* and * *H. Fosteriana*. See under Kentia.

Hyophorbe. Genus of massive, elegant palms with bottle-shaped caudices, attaining medium height surmounted by a crown of beautiful bi-pinnate leaves.

* *H. amaricaulis* resembles a *Cocos* or an *Areca*, but the stem is stout and swollen at the base. Leaves are 1 to 1½ metres in length, spreading and red veined. Known as *Areca speciosa* also. Is ornamental in pot and in ground.

**H. Verschaffeltii*, also called *Areca Verschaffeltii*, is a slow growing very ornamental palm, with leaves 1 to 1½ metres long, arching gracefully at the top and white veined.

Kentia: Handsome genus, resembling the *Areca* to some extent but differing from it in the plants having a decumbent growth in the young state, while the *Arecas* are upright from their young state. *Kentias* are very handsome, hardy palms with pinnate leaves, and with quite smooth and spineless stems and leaf-stalks. They are very valuable in pots for decoration of plant houses or shade gardens. The two species of *Howea* are commercially included in *Kentia*. The following are noteworthy species:—

* *Kentia (Howea) Belmoreana* is an extremely graceful palm with long large gracefully arching pinnate leaves.

* *Kentia (Howea) Fosteriana* is similar to the preceding and is a very graceful beautiful species.

* *Kentia Canterburyana* is another very beautiful species.

* *Kentia Sanderiana* has a very slender stem and gracefully arching leaves. A very beautiful graceful species.

* *K. Lindenii* (Syn. *Kentiopsis macrocarpa*) is a handsome vigorous growing species.

K. McArthurii and *K. Wendlandi* are also handsome.

Korthalsia: Mostly climbers, allied to *Calamus* or Cane palms; only one or two species are worth cultivating in gardens.

* *K. Junghuhnii* is a spiny climbing species, with pinnate leaves.

Latania: Handsome family with large fan-like leaves. In the young state, they are splendid objects for decoration.

* *L. rubra* = *L. Commersonii*: A striking, very handsome, distinct species with a smooth and slender red stem and rich shining, brown-green, red-veined, deeply incised, gracefully recurved leaves. Leaf-stalks are long and smooth and are coloured bright crimson, as are also the ribs of the fan-like leaves. Native of Mauritius and Reunion.

* *L. aurea* = *L. Verschaffeltii*: Also a beautiful species, with stout stem and erect deeply incised, somewhat spreading light green leaves, with ribs of golden colour. The leaf-stalks are ½ to 1 metre long, slender, smooth, and orange-yellow in colour.

Licuala. (*Pritchardia*): Tropical very ornamental fan-leaved palms. Some species are also called Pritchardias. The following are recommended:—

* *L. grandis* (*Pritchardia grandis*); *L. elegans*; *L. gracilis*; * *L. horrida*; *L. peltata*; and * *L. spinosa*.

Livistona: Fan-leaved, very ornamental palms. Suited very well for pot culture.

L. rotundifolia; *L. mauritiana*; * *L. altissima*; *L. Jenkinsii*; *L. australis* and * *L. chinensis* are all very good palms for decoration. *L. chinensis* is the best known and it is also called *Latania borbonica*.

Martinezia: *Martinezia caryotaefolia* and *M. truncata* are both from South America and highly ornamental. The cylindrical stem and leaf-stalks are armed with long spines.

Nipa frutescens: Called Nipa, Water Palm, Water Coconut. It is a soboliferous aquatic plant inhabiting river estuaries and tidal forests in Ceylon, Burma, Chittagong, Malaya and Andamans. It is an economic plant; the leaves are used for thatching houses and matting; the inside of the large fruit is edible; toddy is made from inflorescence (spathe); burnt leaves provide salt. Makes an attractive pot plant, which should be kept in a pan of water with a few grains of salt dissolved in it. Leaves are long, pretty and dark green. Makes a very useful plant in the Water Garden.

Oreodoxa: A small genus of elegant Tropical American palms, with slender rigid swollen stems bearing large terminal pinnate leaves, with long sheath-like stalks forming a cylinder around the summit. They should be sheltered from winds to maintain them in a beautiful state. They are fit for ground culture and are unsurpassed for majesty and grace.

* *O. regia*, called the Royal Palm, Bottle Palm, is a tall and stately growing species, with the stem usually barrel-shaped. Suited for garden avenues.

* *O. oleracea*, called the Cabbage Palm, is also effective in avenues. The stem is slender and swollen at the base. Leaves are 1 to 1½ metres long with gracefully arching leaflets.

Phoenix: Genus of ornamental and economic palms including the Date palm and the Toddy or Sugar palm. The following species are very useful in pots for decorative purposes.

* *P. Roebelinii* is a highly ornamental species, with graceful light feathery arching pinnate leaves, almost hiding the pot from view.

* *P. rupicola*; *P. cycadifolia*; *P. zeylanica*; *P. reclinata* and *P. spinosa* are all good looking. Even the common Toddy palm, *P. sylvestris*, is handsome while young.

Pinanga: Dwarf slender stemmed palms, admirably suited for table decoration while young. They look like Arecas.

* *P. spectabilis* and * *P. Kuhlii* are worth cultivating.

Pritchardia: A small very ornamental genus, with flabellate (fan-shaped) plaited leaves.

* *P. grandis* is a very elegant palm, very beautiful with its immense rounded lace-edged leaves of bright polished green, growing out of a base and forming a cluster.

* *P. pacifica*: Also a very ornamental species, with large broad flabellate plaited leaves, often 1 metre broad.

P. filifera and *P. robusta* are other attractive species.

* **Ptychoraphis augusta**: A very ornamental palm, like the Coconut palm when young.

Ptychosperma: Allied to *Seaforthia* and *Kentia*. Have comparatively slender stems and pinnate leaves.

* *P. McArthurii* (Syn. *Kentia McArthurii*) is a very handsome palm for pot culture, bushy with a number of stems.

Rhapis: Dwarf, rattan-like palms with slender stem and fan-shaped leaves, deeply cut into segments. They are excellent for bushy clumps in shade gardens or for pot culture. They produce very freely large number of suckers and are mainly increased by division of these.

R. flabelliformis (*Ground Rattan Palm*) is a native of China and Japan. Elegant slender growing plant, very useful for planting in shade gardens and growing in tubs.

* *R. humilis* is a more elegant species, with larger leaves than the preceding.

Sabal: Noble looking Palms, natives mostly of U. S. A. and West Indies. Dwarf, ornamental and fan-leaved.

S. Adansoni, *S. umbraculifera*. *S. filamentosa* are some desirable species.

* **Seaforthia elegans**: A striking palms, resembling *Areca alba*. Has a somewhat stout stem. Fit for growing in the ground. Called the Bungalow Palm.

* **Stevensonia grandifolia**: One of the finest cultivated palms. Leaves are between the feather-veined and the fan type. It is a magnificent stemless palm from the base of which spring the copper-coloured stalks, studded with black spines. When young, the leaves are very handsome, being of a rich-cinnamon-brown colour. Difficult to grow.

Thrinax: Dwarf fan-leaved palms including some very beautiful kinds.

* *T. argentea* is a well known species with large fan-shaped leaves. They are shorter than the petioles and silvery-silky beneath.

T. barbadensis; *T. parviflora* and *T. elegans* are all handsome.

Verschaffeltia splendida: A handsome fan-leaved palm, introduced from the Seychelles Islands. Foliage, veined and shaded with yellow and distinct from that of other palms.

CYCADS

Family of small palm-like trees or shrubs, closely related to the conifers in feuctification and having stems marked with leaf-scars. Leaves are unbranched and pinnate, surmounting a stout stem and resembling those of Palms in aspect. The soil suited for their culture is the same as that required by palms and the method of treatment too, is the same. Propagation of Cycads is chiefly by the large bulb-like buds, which appear at intervals on the stem; these grow freely when taken off the tree and planted in well drained soil in a moist shady situation. Cycads are also increased by seeds and suckers. Male and female flowers are borne in separate plants and the female flowers should be pollinated by hand to insure fertilization; seeds should be collected on ripening and sown within a month. All cycads are very slow growing; they may be either grown in the ground or in large pots or tubs. When growing, they should be given partial shade. Of the nine

genera, only three, namely, *Cycas*, *Zamia* and *Macrozamia* are suited for cultivation in gardens.

Cycas: A genus of hardy palm-like plants of great beauty, useful for planting out on lawns or growing in large tubs, for decorative purposes in the young state. The stem is short and cylindrical, and is usually unbranched and terminated at the top by a fine crown of deeply cut pinnate leaves varying length in from $\frac{1}{2}$ to $1\frac{1}{2}$ metres. The plants are very slow in growth and they have a tendency to throw out suckers, from which they are increased. Propagation is also effected by seeds. * *Cycas circinalis*, native of India and Ceylon, $1\frac{1}{2}$ to 3 metres high. The large seeds are made into a sago and hence called the Ceylon Sago. *C. revoluta* is a very much dwarf species with compact dark green leaves. *C. Rumphii* is another handsome species.

Zamia: This genus differs very little in general appearance from *Cycas* but the leaves are more feathery and fern-like. The leaf-stalks have the appearance of growing out in a tuft from the summit of the stem. *Zamias* require partial shade for successful growth. They do well in the ground.

* *Z. integrifolia*; and *Z. lindenii* are desirable species.

Macrozamia: Genus closely related to *Zamia*, growing in swamps near the sea. They are moisture loving and succeed very well in damp places. They rarely seed or throw out suckers in this country and hence have to be imported from Australia. * *M. spiralis* is from Australia. It is a handsome species.

Encephalartos: *E. Hildebrandtii* and *E. caffra* are two other ornamental Cycads from East Africa.

CHAPTER XXII

FERNS AND SELAGINELLAS

Ferns are a very extensive family of plants, comprising of several genera and thousands of species, remarkable for the beauty and gracefulness of their foliage. There is a wonderful variation in the size, habit and appearance of the several species. Ferns in pots are greatly used as groundwork for groups of flowering plants. Cut fronds are mixed with cut flowers in bouquets and vases. Many kinds are useful as subjects for wire or hanging baskets and verandah and plant-house embellishment. On account of their extreme popularity, plant-houses, called ferneries, are exclusively devoted to them.

Ferns are naturally found growing on hills and dales, luxuriating in shady spots overhanging a sheet of water, a running brook, or waterfall; they are found attached to soil mainly composed of light fibrous mould, formed of decayed moss and leaves; they exhibit a greater luxuriance, wherever they grow on lime-stone rocks. It is to be seen thus ferns are not ardent lovers of bright sun-shine; they luxuriate in a still, moist atmosphere; and they thrive in a well drained light porous soil, with a fair quantity of lime in it. If the above conditions are provided for, there won't be any difficulty in growing them. There are several hardy kinds however, as *Nephrolepis exaltata* which would grow in any good garden soil and in situations exposed to sun.

Most ferns thrive in moderate-sized pots, 15 to 20 cms. pots would do ordinarily but for specimen plants, larger but shallow pots are desirable. Those in small pots need repotting every year and those in large pots may be top-dressed annually and repotted once in two or three years. The best time to repot is when the plants begin growth in Spring—from February to April. All dead stems and roots are removed without disturbing the roots much and the clumps are divided into two parts one larger than the other, the larger one being put into the same pot and the other put into a much smaller pot; for, ferns grow and spread rapidly filling the pots with roots

soon. Care is to be taken not to bury the crowns or growing points under the soil. Compost No. 7 recommended on page 127 is the best for general use. Extra drainage is provided for as the plants require to be continually moist at the roots. The atmosphere is kept cool and moist by syringing the ground and the sides of the pot with water. This is particularly necessary in summer. Periodical overhead syringing benefits most ferns; but, there are some ferns, as Maiden Hair Ferns and the Silver and Gold Ferns, which dislike it.

Ferns, in general, may be increased by means of their spores, the dustlike seeds produced on the back of the fronds. Spores are minute seed-like bodies, developed in spore cases (sporangia), produced in lines or clusters on the underside or the margins of fronds and rarely on their whole surface. The spore arrangement in different species and genera vary and that is the basis of fern-indentification. For propagation of ferns from spores, the fronds should be carefully examined frequently so that the spores may be collected as soon as they are ripe. When the sori turn brown, the fronds are cut and allowed to dry in paper bags. Though some kinds germinate even when kept for several years, sowing is done when spores are still fresh. Sowing of spores is done in broad well drained seed pans, half filled with crocks and the remainder, up to 1.25 cms. from the top, with a mixture of small pieces of brick, fine, sifted loam and leaf-mould; the soil is firmly pressed and watered through and the ripe spores scattered over it and immediately covered with a plate of glass. The pan is then placed in a warm, shady situation and placed in a saucer containing water. The spores germinate, throwing small peculiar leaves (prothallus). When these are fit to be handled, patches of them are lifted with the end of a flat stick and pricked out 2.5 cms. apart in well drained seed pans filled with fine soil mixture of equal parts of leaf mould and sand. The pots are carefully watered and kept moist in shade. As the plants become large enough, they are potted singly in small pots. Until fronds are well developed, it is advisable not to water the foliage from above. Propagation by spores may be done at any time of the year.

Ferns are also increased in a variety of other ways, depending upon the habit and mode of growth of the kinds concerned. Amateurs invariably increase their stock of plants by division of the clumps, and rarely resort to propagation by spores, though new varieties are obtainable by the latter method. Those ferns, which have creeping rhizomes, such as *Davallia*, are propagated by cutting them into bits with roots and potting them. In such kinds, the points of the rhizomes can be laid over and layered too into small pots. The best time for propagating creeping rhizomes is Spring at the repotting time. Some species such as *Asplenium bulbiferum* and *A. viviparum* produce a veritable multitude of youngsters on their fronds; in some kinds, these new growths drop off when mature, when they are collected; in others, they are carefully removed from the fronds and planted in moist sand, with their crown uncovered. After they have struck roots, they are potted singly. It is advisable in some cases to lay the entire frond with the buds flat in sand and cover the frond in such a way that the buds peep out of the soil. In course of time, they strike root, giving rise to as many plants as there are buds or bulbils. Some kinds as *Woodwardia radicans* produce a solitary bud at the apex of the frond which is rooted by pegging the tip of the frond into the soil.

Caterpillars and a scale insect, similar to the Sun Jhose scale, at times, attack ferns. Caterpillars of a usually green or brown colour, lie hidden in the foliage and should be picked out. Plants badly infected with scales are better destroyed by fire, as scales are difficult to be treated satisfactorily. If the plant is too valuable to be destroyed, it should be removed far away from the healthy plants lest the infection should spread.

The following are some choice ferns:—

* **Adiantum.** (*Polypodiaceae*): Called popularly the Maiden-hair Ferns. A very extensive genus with remarkable similarity in general aspect. Leaves have usually polished black or purplish stalks and thin delicate blades, simple or divided into fan-shaped segments, with the outer margins revolute, covering linear sori. The fronds cannot be wetted, even by dipping them in water, and hence, the generic name *adiantum* is derived from the Greek word meaning 'unwetted'.

Adiantums are easy of culture and they flourish in the general compost for ferns recommended above, growing on an average about 30 cms. or more high. They do not like being watered or syringed on the foliage and they do not thrive in direct sunlight. Amateurs increase them by division of clumps. When large quantities have to be grown, spores should be sown in well drained pots, supplied with plenty of moisture. In about ten weeks real fronds make their appearance. When these are about 4 cms. high, the young plants are potted individually in 15 cms. pots. In a year, these get filled up by the growing plant and may need to be shifted to larger pots.

Adiantums make excellent pot plants, very useful for staging in the shade garden, in the fernery and in the verandah; many make specimens for decoration of vases in doors and for growing in hanging baskets. The fronds are useful for cutting to be used along with flowers and for making bouquets and button holes. Thus, Maiden-hair Ferns are deserved popular. The following are some of the more attractive species :—

A. aethiopicum ; *A. Bausei* ; *C. concinnum* and its varieties, *A. cuneatum* and its varieties, *grandiceps*, *gracillimum*, *grandis*, *variegatum* ; *A. decorum* ; *A. tenarum* var. *Farleyense* ; *fissum* ; *A. formosum* ; *A. lawsonianum* ; *A. LeGrande* ; *A. macrophyllum* ; *A. mooreii* ; *A. pacotti* ; *A. pectinatum* ; *A. peruvianum* ; *A. tenerum* ; *A. trapeziforme* ; *A. villosum* ; *A. victoriae*.

* **Alsophila** : Called the Grove Fern ; Norfolk Island Fern. A genus of ornamental tree ferns, fit for growing in large conservatories, whose plenty of space is available. The term 'Tree Fern' is usually applied to ferns belonging to the order, Cyatheaceae. Tree Ferns generally have an erect tall stem or trunk, resembling that of a tree. The leaves are large and borne from the trunk at the apex forming a palm-like crown. As the leaves fall, they leave scars on the stem. Tree ferns exist in nature as undergrowths under large trees in large forests, where there is good rainfall. Hence, they love moisture and partial shade. *A. excelsa* and *A. australis* are handsome. Give plenty of water and syringe frequently and tie up moss all round the stem to keep it cool. Only suited

for medium to high elevations. *A. latibrosa* is another handsome species.

Aneimia. (*Schizaeaceae*): Called the Flower-Fern or the Ash-leaved Fern. Group of small-growing ferns, suitable for pot culture or in baskets. Propagated from spores like *Adiantum*. * *A. rotundifolia* is a very desirable species.

* **Angiopteris.** Called the Turnip Fern. Large growing with long fronds, often 1 metre long; very well suited for growing by cisterns in the ground in ferneries or shade gardens. Propagated by offsets. * *A. evecta* grows about 2 metres high. Suited only for up-country.

Aspidium. Not a very ornamental group of ferns. *Aspidium aculeatum* is a well known species, called the "Hard or Prickly Shield Ferns". Its fronds are about $\frac{1}{2}$ metre long, stiff and twice pinnate. *A. auriculatum* is another hardy species. Suited for up-country only.

Asplenium. (*Polypodiaceae*): Genus of attractive ferns, the different species varying in aspect. Some have simple entire leaves; others have fronds, which are finely divided. Propagated by spores, which are produced in great abundance. The following species are important:—

* *A. avis Nidus* is the Bird's Nest Fern, with large shining green undivided fronds, which are nearly 1 metre long in a well developed plant and form a cup-like cluster. A very decorative specimen plant for growing in large tubs.

Other important species of the group are:—* *A. bulbiferum* $\frac{1}{2}$ to $\frac{3}{4}$ metre bearing bulbils at the edges of the fronds and propagated from them; * *A. formosum* (dwarf growing). * *A. caudatum*, superb basket plant with drooping long fronds. *A. lunulatum* and * *A. dimorphum* are others.

Blechnum. (*Polypodiaceae*): Brazilian Tree Ferns. Genus of low growing tree ferns, useful for decoration indoors, resembling *Lomarias* and bearing palm-like leaves. *B. occidentale* with deeply divided and * *B. cartilagineum* with pinnate fronds are very desirable species.

Davallia. (*Polypodiaceae*): Called Hare's Foot Fern or Bear's Foot Fern. One of the most handsome group of ferns with scaly creeping rhizomes, bearing some fancied resemblance to a hare's or a squirrel's foot. Some of the species are

suited for growing in tubs for decoration indoors and some species are excellently suited for growing in baskets. *D. bullata* is well suited for training round fancied frames as birds, animals etc. Some handsome species are :—*D. bullata* (known as Squirrel's Foot Fern) ; *D. fijiensis* and its variety *Plumosa* ; *D. strigosa* ; *D. tenuifolia* ; and *D. canariensis* (Known as Hare's Foot Fern).

* *D. fijiensis* has fronds 45 to 60 cms. long and divided four times into very fine segments. It is capable of being grown as a specimen plant in a large pot or tub.

***Drynaria** : Allied to Polypodiums. An extensive genus, some species being very hardy and suitable for outdoor work in pots. *D. quercifolia* has a large leaves, resembling those of the Oak and it is suitable for growing in seed pans.

* **Gymnogramma** : A group of singularly attractive ferns, noted for their elegance. The undersurfaces of the finely cut leaves of some species are densely covered with yellow or white powder or farina and hence the popular names, the Gold and Silver Ferns respectively. These ferns should not be subjected to overhead syringing at any season. They thrive in moderately small pots. Some handsome Golden Ferns are * *G. sulphurea* (tall and dwarf varieties) ; and * *G. chrysophylla*. Some of the Silver Ferns are * *G. tartarea* and * *G. pulchella*.

Lomaria : Closely related to Blechnum, being smaller Tree Ferns, interesting and useful. *L. gibba* is a handsome hardy species.

Lygodium : Genus of climbing ferns with slender twining fronds and divisions, tongue or hand-shaped. *L. scandens* is a native of Mysore ; it is slender and graceful with exquisite filigree-like fronds ; it thrives very well in the plains and can be made use of to cover pillars of a portico or inside ferneries with great effect. Lygodiums are useful for pot culture over balloons. *L. japonicum* ; *L. palmatum* ; and *L. circinatum* are other attractive species.

Nephrodium : Large genus, midway between Aspidium on the one hand and Nephrolepis and Polypodium on the other hand, with pinnate or compound fronds. As a class, Nephrodiums are very hardy and handsome, being very useful for decoration of verandah and some even outside. There are

several beautiful species, with an average height of 45 to 60 metres, varying in texture, cutting and venation. All the species are easy of culture. * *N. cuspidatum*; *N. molle*; *N. decurrens*; * *N. patens cristatum*; *N. polymorphum*; * *N. setigerum* are some of the more attractive species.

Nephrolepis : An extensive genus of highly attractive hardy tropical ferns. Several species are suited for growing in baskets. The plants are distinguished by the slender runners or stolons produced freely from the old stems, by the pinnate fronds, free veins, roundish spore-clusters arising from the apex of the upper branch of a vein, usually near the margin, and by the kidney-shaped or roundish indusium. Of the more attractive species, the following are noteworthy :—*N. acuminata*; and its variety *furcans*; * *N. cordifolia* and its varieties, * *N. davallioides furcans*; * *N. exaltata* and its varieties such as *elegantissima* and *compacta* * *N. rufescens* variety *tripennatifida*; *N. muscosa*; * *N. Marshallii* and its variety *compacta* resemble bushes of moss about 30 cms. or less high, the fronds being very finely cut and dense, with spongy and soft feeling to the touch.

Onychium : *Onychium japonicum* is a small fern growing about 30 cms. high, with fronds which are four times divided, light and graceful. Fine for indoor decoration.

Osmunda : Small genus of attractive ferns, remarkable for their distinct appearance. The fronds are feather-shaped, plain or crested. The fertile portions are contracted. *O. regalis*, well known as the Royal Fern or the Flowering Fern is the best species. It grows 150 to 180 cms. high, having twice pinnate barren fronds and cylindrical trusses of fertile fronds thrown up in the centre.

Pellaea : Called the Cliff Brake-Fern. Almost all the following are good species, being mostly low growers and suited for growing in baskets. *P. cordata*; *P. falcata*; and *P. geraniaefolia* are useful.

* **Platycerium** : Called the Stag Horn Fern or Elks Horn Fern. The fronds are more or less broad and divided like the horns of a stag. *Platyceriums* are epiphytic and hence can be grown on logs of wood like orchids. They can also be grown in hanging baskets, like Orchids. *P. alicorne* is the common

Elks Horn Fern ; it makes specimens, 30 to 60 cms. in diameter, when suspended in a basket.

Polypodium : A section is known as *Drynaria*. (See under *Drynaria*). A large genus with many ornamental plants. Many of them produce strap-shaped or tongue-shaped, undivided fronds more or less of a leathery character. * *P. quercifolium*, oak-leaved (*Drynaria quercifoali*) ; *P. verrucosum* ; and *P. aureum* (*Phlebodium aureum*) are handsome.

Pteris : Large genus of several attractive species, some of them having handsomely variegated fronds. The following are noteworthy :— * *P. quadriarita* var. *argyrea* has a white band running down the centre of the pinnae ; *P. cretica* ; * *P. cretica* variety *albolineata* has a broad central white band ; *P. geraniaefolia* ; *P. longifolia* ; *P. ludens* ; *P. mariesii* ; *P. palmata* ; * *P. quadriaurita* ; *P. serrulata* and its variety *cristata* ; *P. tremula* ; *P. tripartita* ; and * *P. Victoriae*. All are excellent pot plants.

SELAGINELLA

Called the Club Moss or the Creeping Moss. A large group of mostly tropical plants, with fern-like foliage, the fronds creeping or erect and branched. In some species, the foliage is variegated. The plants are easily recognised by the stems bearing four rows of scale-like leaves. Selaginellas are shade-loving plants and are grown like ferns. They are useful in more ways than one ; some are grown in pans as semi-aquatics ; some are grown on rockeries, making a carpet of emerald green ; some again are used as edging for beds in shade gardens and for covering the surface soil of large tubs etc. ; and the foliage is also used in bouquets in place of Asparagus and fern-fronds. Selaginellas are at their best in the rainy season and the best time to propagate them, which is usually done by division or cuttings of roots with shoots, is during the rains. The following species are noteworthy :— *S. caulescens* ; *S. denticulata* ; *S. erythropus* ; *S. emiliana* ; * *S. serpens* and * *S. Wildenovii*. It is very useful pillars, for covering walls in a moist warm house and should be planted in fibrous peat. *S. laevigata* is an old favourite, a climbing sort, which rambles at will over a shady rockery. Selaginellas love a soil containing gravel and cinders.

CHAPTER XXIII

ORNAMENTAL GRASSES

Grasses. (*Graminae*): One of the most useful families of plants to man. Many of the Grasses are ornamental and are well represented in our gardens. The section of annual grasses, the seeds of which are much advertised, do not, excepting a few, satisfactorily thrive in the plains of India, though on the Hills, they make a good show. They are not only ornamental while growing but their flowers are useful for cutting, being often used in vases with everlasting flowers or independently of them or with other subjects. The seeds are sown thinly in damp weather in 15 cms. pots and covered lightly. The seedlings are thinned out 2.5 cms. apart. In six to eight months, the plants develop into fairly large specimens and bear panicles of flowers. Some of the annual species of grasses make good pot plants, while some thrive well on rockeries. Of the perennial kinds, the large growing species such as the ornamental Bamboo, the Pampas, and the *Gyncrium* look pretty, when planted in clumps or in avenues or by the margins of ponds. The smaller growing perennial species as *Tricholaena rosea*, *Lagarus oratus* (Hare's tail grass), are eminently fitted for pot culture and rockeries.

Most of the grasses are hardy and are easy of culture. They grow in any ordinary garden soil which is not waterlogged, in shade or sun. They are propagated from seeds, by division of root stocks or by cuttings.

The following is a list of select Grasses for cultivation in gardens:—

Agrostis. (**Cloud Grass; Spear Grass**): Hardy annual flowering grasses, with inflorescence, which is light and graceful and is valuable for cutting and for mixing with flowers, or for drying and decoration, when no others are available. *Agrostis elegans*, *A. nebulosa* and *A. pulchella* are some of the good species, growing from 30 to 35 cms. high. Suitable for borders or pot culture. Sow the seeds where the plants are to remain.

Andropogon=Cymbopogon : *A. citratus* known as The Lemon Grass. It has a bushy habit, growing in a clumpy fashion, with long narrow green lemon scented leaves. Height, $\frac{1}{2}$ metre. Propagated by division. *A. halepensis* is very strong growing requiring to be kept in bounds. Produces lovely sprays nearly all the year round.

Apluda aristata : Small grass, $\frac{1}{3}$ to $\frac{1}{2}$ metre high, looking like miniature Bamboo. Suitable for pot culture or for rockery.

* **Arundo Donax variegata** : A bushy reed-like variegated grass, growing $1\frac{1}{2}$ to $2\frac{1}{2}$ metres high, forming a huge clump, the clumps enlarging year by year, throwing numerous cane-like shoots from the ground. The plant is of very great ornamental effect with its variegated green and white foliage, which is very pretty. In a poor soil, the variegation is better developed than in rich heavily manured soil, which is well supplied with water. If a bush has its shoots all green, it can be cut down to the ground level; the new shoots that come up within a short time being highly variegated. A clump, planted on the lawn in an open sunny situation and trimmed occasionally by cutting away straggling shoots, looks superb and grand. Propagated by division of root stock and by cuttings.

Arundo conspicua : Grows $2\frac{1}{2}$ to 3 metres high, bearing large drooping racemes of silky white flowers. Suited only for hill stations. Thrives in light sandy soil in open sunny situation.

* *Arundo metalica* : A grass with bronze leaf, grows to about 1 metre and loves shade.

Bambusa. (Bamboo) : Bamboos are a very useful class of Grasses. The dwarf kinds serve as barriers along the boundary lines in spacious gardens. The dwarf ornamental species are of high decorative value, planted in groups or along the edges of ponds and streams. The taller species, being very bushy and large, are kept at a distance from the residence. Some of the Japanese dwarf species may also be grown in tubs or pots. Bamboos thrive in any kind of soil and require plenty of water for quite satisfactory results. The following are a few select species:—

B. aurea, ornamental with yellow stems and light open foliage. Native of Japan.

**B. aurea variegata* ; 2 to 3 metres. Stem richly ornamented with bright golden stripes. The foliage is light and open and the bush with its light green foliage and the golden yellow and green stems is very ornamental. Propagated by stem layering. The species is well suited for cool places.

**B. Fortunei argentea variegata* is a very graceful conservatory pretty little plant about 30 cms. high, having leaves striped with green and white. Flourishes in the open in cool places.

**B. Fortunei aurea* is 30 cms. in height, being a dwarf variety of *B. Fortunei* ; the foliage assumes at certain seasons a bright golden yellow colour. Thrives better in cool localities than in hot plains.

B. japonica is about 1 metre high, making a splendid plant in a shady situation.

B. nana grows 1½ to 2 metres ; it is a pretty Chinese bamboo can be used for hedging where water is plentiful. Propagated from seed and by division of stems.

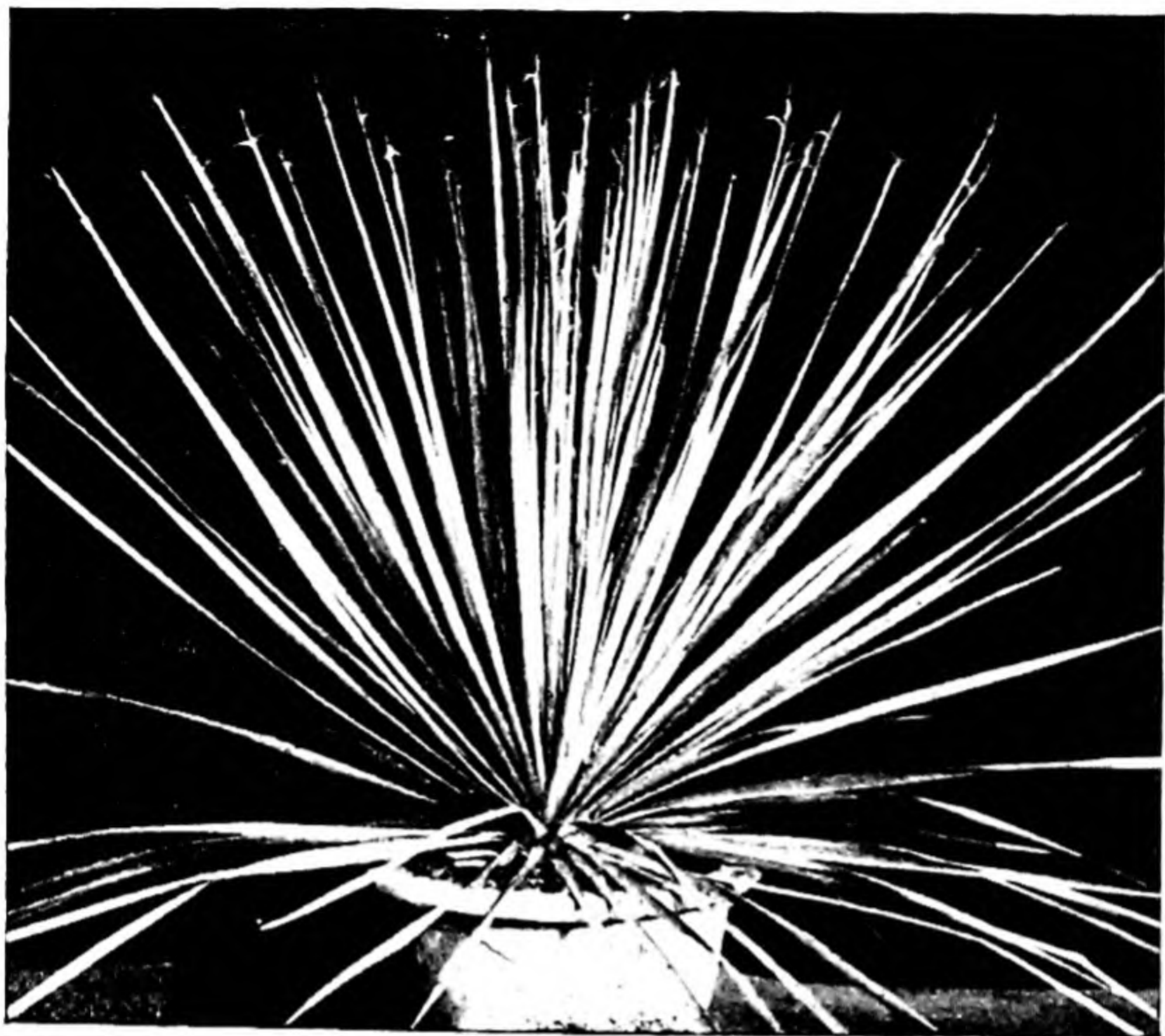
B. nigra (*Black Bamboo*) is an interesting species, growing 5 to 6 metres high, with lower portions of stem coloured purplish black.

B. siamensis is very graceful, growing to a height of about 5 metres. The foliage is light and feathery and borne in dense graceful plumes.

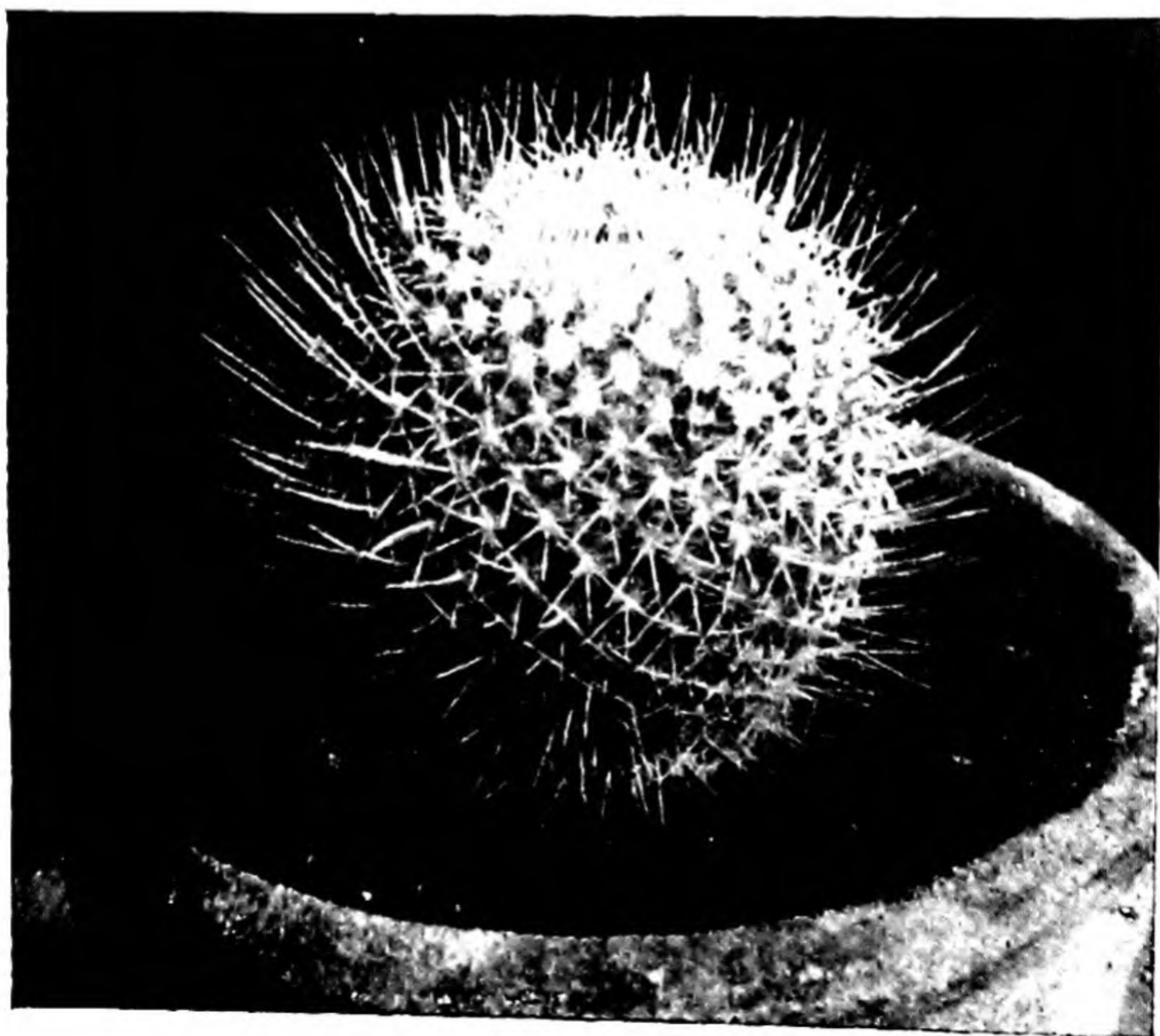
B. tricolor is a dwarf variety of variegated bamboo, about ½ metre high, with bright green leaves striped with creamy white and edged with red.

**B. vulgaris* (*Golden Bamboo*) is a very handsome species nearly 6 to 7 metres high, with stems, streaked with bright bands of gold and green, and 7.5 to 10 cms. in diameter. Thrives best on the banks of streams and in hollows where there is lot of moisture in the sub-soil.

Briza maxima (*The Quaking Grass*) : Thrives better at medium elevations than in the plains, bearing large flower spikelets suspended by delicate hair-like stalks and moving gracefully with the breeze. Mainly grown from seeds, which are sown when the monsoon is nearly over. The inflorescence is useful for cutting.



DASYLIRON



MAMMILLARIA



DRACAENA DEREMENSIS BAUSEI



Eragrostis elegans. (Feather Grass; Love Grass) : An annual with small spikelets, which are light, feathery and graceful, and are useful in making flower bouquets. Seeds are sown during the monsoons.

***Eulalia japonica.** A Japanese graceful grass growing 1 metre. The variegated form with white and green leaves is very pretty. *Variety gracillima* has narrow leaves with white midrib. *Variety zebrina* has transverse yellow streaks. They are suited for culture in the open on hill stations and for pot culture in conservatories at medium elevations.

Gynerium argenteum. (Pampas Grass) : Synonymous with *Cortadeira argentea*, is a tall grass, very ornamental with its large terminal panicles of silver white feathers and long ribbon-like leaves. Propagated by division or from seed. Thrives better at cooler places.

***Oplismenus Burmanni variegatum** : Synonymous with *Panicum variegatum*. Very ornamental creeping grass with pretty variegated leaves, striped rose-pink, green and white. Thrives better in shade than in exposed positions. Very useful for hanging baskets and for covering the surface of large pots and tubs. Propagated by runners.

***Phalaris arundinacea variegata** (Ribbon Grass; Gardner's Garter) : A small variegated grass, suited for pot culture, edging and rockeries. Grows 2 to 2½ metres high. The leaves are longitudinally striped with silvery white. Propagated by division. Protection from afternoon sun is necessary.

Pennisetum longistylum :—A native of Abyssinia, handsome, growing 1 metre high, bearing pink bullrush-like flower heads.

Phyllostachys. (Whangee Cane) : Ornamental Bamboos, from Japan, about 1 metre high with graceful habit of growth.

Thyrsanolaena agrostis. (Bouquet Grass) : A large bushy spreading reed about 2 metres high, with leaves 30 cms. long by 7.5 cms. wide, producing during early hot weather, flowers in large, very graceful terminal clumps, which are at first purplish and then turn to brown colour. Requires plenty of water. Very ornamental, when placed in the centre of small shrubs.

***Tricholaena rosea.** (Natal Red-top Grass) : Known also as the Ruby Grass. A very handsome plant, easily raised from seed, growing $\frac{1}{2}$ to $\frac{3}{4}$ metres high, bearing masses of purplish crimson flowers. They are excellent for cutting.

CHAPTER XXIV

SUCCULENTS

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The term 'succulents' is used with reference to certain specialised forms of plant life, which store moisture in their foliage, or in their stems, or in their rootstocks, which enables them to live through periods of drought. Many succulents, majority of Cactii for instance, come from the exceedingly hot and arid or semi-arid regions of Africa, Asia, and America (especially Mexico). Some choice kinds, such as Echeveria, are natives of the higher regions of mountains, which receive practically no rain compared with the lower regions, where the ground is frozen and therefore the soil is physiologically dry for the plants and where in the rarefied atmosphere, winds have a more drying effect on the plants, in spite of the cool atmosphere. Thus, succulents, as a class, whether from the hot or cool regions, are subjected to a lack of supply of water, which is most necessary for plant growth and life. They are plants which have necessarily adapted themselves to the peculiar conditions of soil and climate they live in. They have mostly, a shallow root system which helps them to collect quickly the dew falling in the night. Their leaves are fleshy with plenty of water-holding tissue; they are often reduced in size; they are covered with a thick epidermis with only a few stomata; they are often coated with a whitish or blue wax or wooly hairs; they are, in some cases peculiarly arranged, for instance in a rosette form, which enables them to close during strong sunshine—all, contrivances to retard transpiration and save water for the plants. Succulents manufacture their food mainly from the atmospheric air and require very little water in the soil for their growth. Hence, they have comparatively very few roots.

Plants belonging to several families are included in 'succulents'. Majority of them belonging to Cactaceae, Cereus, Echinocactus, Epiphyllum, Opuntia, Mammillaria and Phyllocactus are all Cactus plants. Amaryllidaceae is represented by the remarkable genera of plants as Agaves and Furcraea.

Liliaceae provides excellent genera as Yucca, Aloe and Gasteria. Cassulaceae furnishes such important groups as Bryophyllum, Cotyledon (Echeveria), Crassula, Kalanchoe, Sedum and Sempervivum. Aizoaceae contributes the Mesembrianthemum group which includes some best flowering and quaintest mimicry plants. Other natural orders as Euphorbiaceae, Bromeliaceae, Asclepiadaceae, and even Compositae add numbers to the list of succulents.

There are a number of succulents which attract the interest of the plant lover by their peculiar form or grotesque appearance, or pretty flowers. Several kinds are of high ornamental value, being effective in groups of the same or different kinds or as single specimens in pots or planted in the ground. Large kinds, as the variegated forms of Agaves and Furcraeas and Yuccas are very effective as single specimens on lawns. Yuccas with their beautiful symmetrical evergreen foliage and the long and showy panicles of large snow-white waxy flowers serve as excellent border plants with a shrubby background. Epiphyllums make one of the most interesting and beautiful pot plants grafted on stems of Cereus. Out of curiosity, enthusiasts collect Cactii from all over the world. Some of the globular and cylindrical species are useful for pattern or design work. A permanent and tasteful planting of several kinds of succulents on a sloping ground or in raised beds or on rockeries, is a source of perennial interest.

Succulents which are natives of arid regions can be grown in all places in India. Those coming from the higher mountain regions can only be successfully grown in a sub-tropical climate, from medium to high elevations. In the plains and at medium elevations, the latter type of succulents live for a few seasons only, if protected from sunshine. As a general rule, they require fresh air, light, sunshine, porous sandy soil, perfect drainage, comparatively dry atmosphere and moderate watering. Many make a mistake in thinking that succulents need no watering and in applying water at long intervals on the surface of the soil, which makes them rot at the base. During the growing season, succulents do need regular watering. As water falls off them when pots are full of them, it is advisable to water the pots from below and to allow the soil to dry out

before watering again.

For succulents from arid regions, the compost may be made up of a part each of loam, broken bricks, sharp sand, quarter part of well decomposed leaf mould and sprinklings of lime and granulated charcoal. For succulents from cool regions, a less coarse compost made richer with more of leaf mould is used.

Succulents are propagated in a variety of ways. Though vegetative means may be more desirable and quicker in several species, almost all kinds may be raised from seed. For sowing seeds, a 10 cms. pot which has been sterilised by soaking and washing it in a solution of copper sulphate is used. As seedlings will have to remain in the pot for a considerable time before they are pricked off, sterilization of the pot is necessary to prevent algae or moss covering it. The soil used should be very sandy with very little leaf mould. The pot is filled to at least one-fourth full with bits of crock for drainage and the soil is put on the drainage till it comes to 1.75 cms. from the top of the pot. After levelling the soil and pressing down lightly the seeds are scattered thinly on the surface, and covered lightly with fine sand or fine powdered brick. The sand or brick serves to prevent the seedlings from damping off in their young stages. The pot is then watered through the drain hole as shown in figure 31. The pot is to be kept on a bench insulated in a vessel of water to keep off ants which are fond of Cactus seeds. Seedlings may appear in about ten days or more. When they are just large enough to be moved without damage, they may be pricked off into soil in seed-pans containing a little more leaf mould than before, and left in them till they grow big enough to be individually potted. Some species as Agaves are increased from the bulbils, which drop off the mature plants from the mature column of flower-stalk. Epiphyllums and Phyllocactii are increased by cuttings. The cuttings should be kept by till they form a corky layer over the cut-surface and then inserted not too deep in sand. Some kinds as Bryophyllum, Kalanchoe and Echeveria are multiplied easily from leaf-cuttings. Epiphyllums and Phyllocactii are herbaceously grafted on Cereus stocks for durable plants.

The following are some select succulents, which are cultivated in gardens :—

Agave. (*Amaryllidaceae*). Called the Century Plants on account of mistaken impression that they take 100 years to flower; actually they take 8 to 40 years to flower. Evergreen massive growing plants, with no stem or very short stem and leaves, mostly in a close rosette. Leaves are usually stiff, more or less leathery and fibrous and persisting from year to year. The margins are mostly armed with teeth and the apex tipped with a usually pungent spine. Agaves are very slow in growth. After a number of years, the period varying with the species, a large flower stalk is shot up like a column from the terminal bud of the plant bearing innumerable flowers arranged on it. These flowers last for several days and months and form the seeds or young bulbils. The plants gradually die after flowering, as seeds ripen. Propagation is from seeds or bulbils or suckers.

Agaves are a useful class of plants, many of them furnishing fibre. Species of Agaves vary so much in size and form that they may be used in a great many ways. There are several highly ornamental kinds, variegated or otherwise, which are very effective in tubs, vases, large pots, or on lawns as single specimens or in groups or plunged in rock-work. Some are serviceable as fencing plants, growing $1\frac{1}{2}$ to 2 metres high.

Agaves come from arid regions where they have a hard struggle to exist and so they can be grown with little or no care. They are very hardy and drought resisting, thriving on well drained soil, inclined to be sandy. For compost for potting, loam and sand can be mixed in equal proportions and to the mixture may be added some leaf-mould.

Some select large sorts of Agaves are :—* *Agave americana variegata* is handsome, with leaves measuring $1\frac{1}{2}$ metres or more in length, and 15-20 cms. in breadth. They are dark green in the centre and are broadly margined with rich yellow and are armed at edges and at apex with stout spines. The rosette of leaves is $1\frac{1}{2}$ to $2\frac{1}{2}$ metres wide and 1-2 metres. * *Agave americana mediopicta* is similar to the above but has yellow leaves edged with green. * *A. Franzosoni* is a large bluish

green kind, with large broad recurved leaves, more imposing and beautifully coloured than *A. americana*. Rosettes are as large as $3\frac{1}{2}$ metres in circumference.

Some select medium sized sorts having a spread of $\frac{1}{2}$ to 1 metre and attaining to height of about $\frac{1}{2}$ to $\frac{3}{4}$ metres are :—*A. densiflora*; *A. dasyliroides*; **A. filifera* has erect leaves, 30 cms. in length and 2.5 to 4 cms. in breadth, tapering to a point and armed with a stout spine and clothed densely with white filaments; **A. Ghiesbreghtii* is a fine plant with leaves which are slightly curved inwards, and are bright green in colour and bordered with red and armed at edges and point with bright red spine; *A. heteracantha* is very similar to *A. densiflora*; *A. Schidigera* is similar to *A. filifera* but is of a looser habit; **A. Woodrowii* (Syn. *Augustifoli marginata variety Woodrowii*) is a very pretty species with dwarf compact growth and creamy leaves with pale silver-grey stripes running down the middle of the leaves; **A. Verschaffeltii* is another handsome species. **A. parassana* has almost spherical rosettes of light bluish green leaves, 30 cms. long and 10-20 cms. broad tapering to a point and ending with a brown spine, 2.5 cms. long; the edges of the leaves are sinuous and toothed, the upper half covered with sharp spines.

Some compact growing Agaves, which have a spread of about $\frac{1}{4}$ to $\frac{1}{2}$ metre and growing to a height of $\frac{1}{2}$ metre are :—*A. Crucifera Jacobi*; *A. ensiformis*; *A. stricta*; *A. Victoria-Reginae*.

Aloe. (*Liliaceae*): Genus of plants, which are ever-green with ornamental soft succulent thick leaves, often prickly or spiny and often arranged in a rosette and resembling the Agaves very much. Some species bear attractive tubular flowers. A flower stalk is produced at the side of the rosette instead of the centre and hence the aloe continues to live and flower year after year. Some species have variegated foliage and are suitable for pot culture. Aloes require much the same treatment as Agaves. If exposed to rains, aloes are apt to perish from water collecting between the leaves and causing them to rot at the junction with the stem. Propagation is from seeds or suckers. They are useful on rockeries where Cactii and other succulent plants are grown.

Some attractive large growing species are :—* *A. abyssinica* is showy when in blossom in January and February, with its large flower stems bearing small bright vermillion coloured flowers. A majestic looking plant with dull green leaves, which are $\frac{1}{2}$ metre by 16 cms. the edges being clothed with blunt distant spines; *A. arborescens* and * *A. ferox* are handsome. Some of the small sized attractive species are :—* *A. aristata*; * *A. brevifolia depressa*; * *A. saponaria*; * *A. variegata* and *A. eru.*

Bryophyllum calycinum = Kalanchoe pinnate. (*Crassulaceae*): The name is derived from bryo, to sprout, and phyllum, a leaf, alluding to its leaves giving out buds; and calycinum, alluding to the remarkable calyx of the flowers. *Bryophyllum* is an erect growing succulent herb, $\frac{1}{2}$ to 1 metre high with thick fleshy simple or tripartite leaves, bearing yellowish red flowers in large terminal paniced cymes. It is easily cultivated and makes good pot plants and serves well on open rockeries. The compost best suited for it is a mixture of two parts of sandy loam, one part old mortar rubble and leaf mould. Is easily propagated by leaves, simply laid on the surface of moist sand. Requires through drainage. *B. Daigremontianum* and *B. tubiflorum* are two other attractive species.

Cereus. (*Cactaceae*): Curious looking, long stemmed, vigorous growing, thorny, very hardy plants, *C. grandiflora*, *C. triangularis*; *C. quadrangularis* are all grand night blooming leafless climbers, reaching the tops of tall trees and blooming at the beginning of the monsoons. They are too large and too coarse to be admitted into any but gardens of great extent. Flowers are large, white, and scented, but unfortunately only in the night. The flower-bud with a slice of the stem cut off with it and taken indoors begins to open after it gets dark and expands to its full beauty by midnight. Large cuttings, $\frac{1}{4}$ to $\frac{1}{2}$ metre long, are inserted in sand and after they strike and establish themselves as independent plants, they are used as stocks for grafting *Epiphyllum* or *Phyllocactus*.

Cotyledon (allied to *Echeveria*) (*Crassulaceae*). Called by some "Oyster Plant". *Echeverias* are small succulent herba-

ceous perennials, 7.5 to 15 cms. high, with dense rosettes of small leaves, producing racemes of flowers, which should be removed. They are natives of the Cape of Good Hope, southern N. America and northern S. America. They do not thrive in the plains but do very well from medium to high elevations. Protection from severe sun is necessary in hot localities. They are propagated from suckers and by leaves taken with the dormant bud in the axil of the leaves and rooting them in sand. The cuttings should be very sparingly watered or not at all till roots are formed. Echeverias are intolerant of too much wet in the soil. They are very useful for edging flower beds or for planting on rockeries, or in carpet beds, in hill stations. There are several species, which are found in Indian gardens such as *E. gibbiflora* and its variety, *metallica*; * *E. secunda*; *E. glauca*; *E. agavoides*; *E. globosa*.

Crassula. (*Crassulaceae*). Only fit for hill stations. Small succulent herbaceous plants suitable for pot culture, showy in flower with Phlox-like trusses. *C. nitida* and *C. miniata* are note-worthy species.

***Dasyliiron.** (*Liliaceae*). A genus of very ornamental evergreen remarkable looking plants, suited for planting on lawns or growing as pot plants for decoration. The leaves are glaucous green, grass-like and symmetrically arranged all round the short thick stem drooping gracefully all round. Flowers are produced after many years on a long stalk, $2\frac{1}{2}$ to 3 metres high. Cultivated just like aloes. * *D. graminifoliam* and *D. recurva* are attractive species. Propagated from seed.

Echinocactus. (*Cactaceae*): Popularly known as Hedge-Hog Cactus. Small unbranching, ovoid or globose succulent, prickly, very curious looking plants. There are numerous species with "ferocious and wonderful spine formation". *E. echidnea* is very curious, resembling a ribbed melon of the size of a cricket ball with star-like arrangement of thorns along the ribs. Bears in February and March pretty delicate pinkish white flowers in little groups near the summit of the plant. *E. Grusonii*, called the "Golden Barrel" is a large, ribbed green ball, armed with straight golden yellow spines. *Ferocactus* and *Notocatus* are closely related plants, similar in appearance and spine formation.

Echinocereus. (*Cactaceae*): Low growing plants, forming groups or clusters. They bear annually large flowers in proportion to their size, though in small pots.

Echinopsis. (*Cactaceae*): Also called Hedge-Hog Cactus. Small spiny succulents, which are low and usually round or barrel-shaped or semi-columnar. Most kinds form detachable offsets. Suited for growing on rockery or in small pots for their interesting flowers, which are white or light pink, large with long tubes. *E. multiplex* is an erect unbranching plant, with numerous spine covered angles. Propagated by offsets. *Lobivias* and *Mediolobivias* are allied plants bearing quite attractive flowers with shorter tubes.

Epiphyllum. (*Cactaceae*): Epiphyllum is a large genus of plants with flattened succulent stems, resembling a combination of straps or ribbons growing out of each other in succession. Popularly known as Christmas Cactus or Crab Cactus. The plants are spineless and bear usually large attractive white or red or yellow flowers. The best known species *E. truncatum*. It is a delicate, fragile, dwarf perennial pot plant bearing in great profusion in the cold season large white, pink, or rose flowers. It is raised by cuttings; bits are broken off the plant and inserted in sandy soil, which should be kept on the dry side till the roots are well developed. The rooted plant may be potted in a small 15 cms. pot, which is immersed in a larger pot which should be filled to the brim with gravel on a level with the edge of the inner pot to support the plant and thus prevent it from being blown over by wind. The soil best suited is a mixture consisting of three parts of silver sand, two parts of well rotten sifted leaf-mould, and one part of red earth. Partial shade and shelter from wind necessary. Best grown as a dwarf standard grafted on *Pereskia* or *Cereus grandiflora*. A rooted stem of *Cereus*, about 45 cms. long, is grown in a 25 cms. pot. When it is sappy, its top is sliced away by a clean horizontal cut and a slit is made in the centre of the top so cut, just large enough to admit the wedge-shaped end of the flat cutting which is introduced about 2.5 cms. deep into the slit. The cutting is fixed in place by passing a thin wire or a broom stick sharpened at one end through the stem of the *Cereus* and the cutting, holding them together. The

top portion of the stock is tied round with raffia or plantain fibre to close the slit. The portion operated upon is then covered over with grafting wax or grafting clay to exclude air and water. If the operation is successful, the graft unites with the stick and in the course of a year, the plant develops a head covering about 0.5 square metre of space. The plant, which grows on the stock, should be supported below by a neat circular frame or bamboo 'thattie'.

Euphorbia. (*Euphorbiaceae*): Large genus of varied forms and growths. In many species, stems are thorny, columnar or globular, re-embling Cactii with which they are mistaken. Leaves are absent in many species, thorny if present. Stem and leaves discharge poisonous milky juice when punctured. Flowers are insignificant. *E. alicornis*, *E. pseudocactus*, *E. echinus*, *E. verrucosa* are some noteworthy species.

Furcraea=Foureroya. (*Amaryllideae*): Ornamental foliage plants resembling Agaves, with long fleshy and fibrous leaves, armed with spines. They are cultivated like Agaves. The variegated species are very effective on lawns and on open rockeries with Cactus plants.

**F. Watsoniana* assumes giant proportions, growing 1½ to 2 metres high and attaining a spread of 1½ to 2 metres. The leaves are nearly 1 to 1½ metres long and are very beautifully variegated yellowish white, white and light green. The flower stem resemble that of an Agave and bears innumerable bulbils, from which the species is propagated. A very ornamental and noble plant, very well suited for planting in a lawn and on open rockeries. *F. Lindeni* is also a good species with green, cream edged leaves. *F. gigantea* is a very large growing species very useful as a hedge plant. It is cultivated for fibre.

***Gasteria.** (*Liliaceae*): Aloe-like small evergreen succulent plants with fleshy thick, often prickly, distichously arranged, tongue-shaped leaves, which are green, spotted with white or purple. Cultivated like Aloes. Propagated by offsets and leaf cuttings. Useful for rockeries in shade. *G. trigona*, *C. verrucosa* and some others are attractive. Native of S. Africa.

Haworthia. (*Liliaceae*): Small attractive plants from S. Africa with or without a short stem and fleshy leaves in rosettes or closely overlapping and arranged in several rows

and often covered with pearly tubercles. Require semi-shade and are liable to get sun-burnt. Easily propagated from offsets, which are produced freely and grown with ease as Aloes and Gasterias. *H. maragaratifera*, *H. radula*, *H. corymbiformis* are some well known kinds.

Kalanchoe. (*Crassulaceae*). A genus of dwarf succulent, flowering shrubs resembling *Bryophyllum*, with thick fleshy leaves from which they are propagated in the same way as *Bryophyllum*. Flowers are produced in terminal clusters and are very showy. The colours are scarlet, yellow, or orange or white. Easily cultivated, requiring open sunny situation and through good drainage and sandy soil, similar to that recommended for *Bryophyllum*. Useful as pot plants and on rockeries with cactus plants.

K. tubiflora is a perennial succulent herb with quaint tubular striped leaves, bearing adventitious buds at the ends of the peculiar teeth-like apex of the leaves. The tiny buds fall as they ripen and root freely. Flowers are tubular with a spreading limb, yellow or ochre suffused with red and clustered in erect pretty panicles.

K. Blossfeldiana = *K. globulifera* var. *coccinea* grows into a tiny succulent shrub about 30 cms. high with unbranched, erect, smooth stems and dark green shining leaves, edged red. Scarlet flowers are borne in profusion. Propagated from seeds sown in sand and kept moist by covering with a pane of glass. Fresh plants should be raised often to replace old ones.

Other species to grow are :— *K. Kirkii* ; *K. flammea* ; *K. marmorata* ; *K. crenata*.

Mammillaria. (*Cactaceae*). Popularly called, "Nipple Cactus or Elephants Tooth Cactus". Dwarf plants with leafless cylindrical or globular stems, bearing evenly over their surface, small tubercles somewhat resembling the teats of animals, each tubercle being crowned by a rosette of stars of hairy spines. Propagated by offsets. *M. glauca*; *M. megacantha*; * *M. nobilis* and some other species are pretty.

Mesembrianthemum. (*Aizoaceae*). So named from *mesembria*, midday, *anthemon*, flower. Known as Fig Marigolds. A large genus including many interesting and most brilliantly flowered succulents and the quaintest in the stemless plants,

many of them being mimicry forms of coloured pebbles or stones. The shrubby and the trailing species are very useful on rockeries or on sunny banks. They are natives of arid semi-arid regions, covering the ground with plump foliage and bearing Daisy-like very pretty flowers of white, yellow, orange, crimson and mauve colours, opening only in bright sunshine. A well drained open soil, mainly consisting of sandy loam and small broken bricks, suits them best. Watering is an important operation in growing them. The ground only should be wetted and not the plants, as the water stands up in drops and causes sun-burns on the leaves. No watering should be done during the resting period of the plants. They are easily raised from seeds, sown in October in the plains and in March on the hills, in wide shallow pans, containing good soil below and a layer of sand above. They may also be propagated from cuttings, which should be dried in the sun for a couple of hours or kept by for two or three days, before putting in sand for striking.

Nopalea coccinellifera. (*Cactaceae*). Called the Spineless Cactus. A native of Mexico, growing $1\frac{1}{2}$ -2 metres high. Branching, leafless, with pear-shaped segments. Bears red flowers.

Opuntia. (*Cactaceae*). Branching leafless shrubs with circular or oval tubercles covered with tufts of sharp spines. Some kinds are, however, spineless. *O. Dillenii* (Tam. "Chappathi Kalli") is the common fencing plant and the pest in villages. Its spread is controlled by the Chochineal insect which feeds on it. * *O. microdysis* is an ornamental dwarf, erect, bushy plant, dotted with beautiful very small golden-yellow spines. Suitable for rock work or pot culture.

* **Phyllocactus.** (*Cactaceae*). Known as Leaf Cactii. Phyllocactii are among the most beautiful Cactus plants which are small shrubs with flattened leaf-like branches, very much like Epiphyllums in appearance. They bear brilliant flowers in long succession from the sides of their growths. They are produced from July to September and in summer, and rival Roses and Water Lilies in beauty. Propagated by cuttings or by grafting on *Cereus* stocks, as Epiphyllum and grown in the same way. *P. roseus*; *P. crentaus*; *P. amabilis*; *P. coccineus*;

P. grandis are some of the attractive species. Most suited for hill stations.

Phyllocactus. (*Noctainum*) : In the rainy season bears white scented flowers from flattened leaf like branches during nights. In the morning they fade and lose the scent.

Sansevieria. (*Haemodoraceae*) : Quaint hardy perennial plants producing densely cartilaginous sword like leaves from a creeping rhizomatous root-stock. Grown for the variegated leaves, on rockeries. The common species is *S. zeylanica* which has erect strap-shaped leaves, $\frac{1}{3}$ to 1 metre long, which are green, striped with grey bands. Its variety *Laurentii* is very beautiful with the leaves, having a broad margin of bright creamy yellow. *S. cylindrica* has cylindrical green leaves. All varieties are suited for pot culture or rock work.

Sedum. (*Crassulaceae*) : Sedums are popularly known as "Stone Crops". They are showy succulent herbs, about 10 cms. in height, useful for rockery, baskets, vases, and carpet bedding. Propagated from seeds. There are both annual and perennial species. Not suited for plains, *Sedum pexangularis* seems to be a species which can be satisfactorily grown at low elevations.

Sempervivum. (*Crassulaceae*) : Popularly called "House Leek", Sempervivums are thick, fleshy, usually stemless perennial herbs or sub-shrubs, with leaves mostly in rosettes. They are very useful for planting on rockeries, carpet-beds etc. The plants increase by rosettes or offsets which are sent out by the parent plant, thereby suggesting the other popular name "Hen-and-Chickens". Flowers are produced in panicles, in shades of rose, purple, white, and yellow but the plants are grown only for their attractive foliage and fine form. *S. soboliferum*; *S. tectorum*, *S. arachnoideum* are some of the pretty species. Closely related to Sedums and like the latter thriving only at medium to high elevations.

Stapelia. (*Asclepiadaceae*) : Called Carrion Flower and also star-fish flower a curious genus. Very dwarf Cereuslike plants bearing big flowers of a vivid hue, usually possessing an offensive odour. Love drought and sunshine. Need water only in summer. Propagated by cuttings dipped in sand. The

following are some desirable species :—*S. gigantea*. Stout. 15 to 20 cms. Purple and yellow flowers ; *S. grandiflora*. 20 to 30 cms. Flowers, purple and grey ; *S. hirsuta*. 15 cms. Flowers, pale yellow with red wrinkly stripes ; *S. variegata* 5 to 10 cms. Variable colour of flowers, green and yellow with regular longitudinal dark brown markings in lines.

Yucca. See page 357.

CHAPTER XXV

ANNUALS, BIENNIALS AND HERBACEOUS PERENNIALS

Annuals belong to that class of plants, which attain their full growth from seed, flower and die in one year or one season. Mostly, they complete their life history in 3 to 6 months. They comprise of several of the most beautiful and easily grown plants, widely varying in form, habit of growth and colour, furnishing a good show of blooms for comparatively small cost and amount of labour involved in raising them. Annuals are very effective, grown either in pots or in the ground and hence they deserve extensive cultivation though they may not be of lasting interest as perennials. Annuals, by themselves, without the aid of other plants can keep the garden full and gay all the year round if they are raised by sowing seeds at regular, well-timed intervals. Many annuals have quite a long period of bloom, extending over several weeks; and the duration of this period is invariably lengthened if they are not allowed to seed, by regularly picking off fading flowers. There are special qualities possessed by annuals, which befit them for certain purposes. Where one lives in a rented house or his stay in any place is short or uncertain, annuals come in handy and offer an easy, quick and economical way of furnishing the plot of ground to feast the eye. Again where one starts a new garden with permanent plants such as shrubs and trees, the garden can be kept interesting and full of flowers by annuals till the more permanent features are getting established.

There are quite a large number of annuals which are suited for almost all situations and purposes in the garden. For instance, for edging and for bordering walks and beds, among others, *Ageratum*, *Candytuft*, *Lobelia erinus*, *Phlox Drummondii nana compacta*, *Torenia*, dwarf Marigold, *Alyssum* and *Brachycome* are very useful; for hanging baskets, *Alyssum*, *Lobelia gracilis*, *Petunia hybrida pendula*, *Torenia asiatica*, trailing *Nasturtium* *Verbena* etc., are useful; climbing



Plate 5 : KSG'S CROTON : SRI KRISHNARAJA

types of annuals as *Cobaea scandens*, varieties of *Convolvulus* (Morning glory), tall *Nasturtium* and *Mina lobata* are serviceable for growing in pots over balloons for covering trellis work; for massing in beds, there are Asters, Phlox Drummondii, Pinks, Salvia, Zinnia, Verbena, and too many others for detailed mention; for planting in shrubberies in vacant spaces, Sun-flower, Hollyhock, tall growing species of *Amaranthus*, Spider-flower, *Tithonia*, etc., do quite well; *Kochia* is a beautiful foliage plant, making beautiful plants having the appearance of clipped *Cupressus*; several species of *Amaranthus* have very handsome coloured foliage, for which they are grown.

Annuals, with very few exceptions, thrive better and look more natural and effective in the ground than in pots. Particular annuals thrive best in particular periods of the year. Some are sub-tropical in their requirements and grow to perfection from medium to high elevations. The chief factors which determine the success in the cultivation of annuals in any locality are rainfall and temperature. It may safely be mentioned that cultivation of annuals in places with very heavy rainfall during the rainy season is an almost hopeless task. If the temperature is comfortably low and the rainfall only light, most of the popular annuals can be grown successfully. Annuals may roughly be put under three groups:— (1) Rainy-season annuals, which can stand more rain than others and therefore grown to flower during the rainy season. The time for sowing them would be from April to May in most places. (2) The Cold-season or winter annuals, which thrive and bloom best during winter. These are sown in September to October. (3) Hot-weather annuals, which are required for blooming from March to May, are sown in December to January. On the hills, the half-hardy and tender annuals which cannot survive frost are sown in Spring—in March to May. The hardy annuals may be sown either in Spring or in August to October, if they can be suitably protected in winter.

Seeds may be sown in seed-pans or seed-beds as the case may be, according to the quantity of plants required and the nature of the seeds themselves. Some annuals like *Calendula*, *Gypsophila*, Poppy and Larkspur, which do not transplant

well, are broadcast in the beds themselves, where they are wanted to grow. Methods, of sowing seeds of different sizes are detailed in pages 64-68. The preparation of ground or beds in which annuals are grown is explained in pages 178-181. How young seedlings are to be looked after is described in pages 68-71. Those annuals which profit by constant shifts are sown in seed-pans or seed-beds and pricked at suitable distances apart in prepared soil in pans or nursery beds and then planted out in places where they are grown finally when they are large enough. For soil best suited for sowing, see page 64. Compost 1 or 2 mentioned in page 126 suits most annuals. Certain annuals as Nasturtiums make vigorous leafy growths and produce but a few flowers in the soil is very rich; in the case of such plants, a happy medium conducive both to flower and leaf production should be struck at; generally, if they are planted in beds heavily manured for a previous crop, satisfactory results are obtained. Such of the kinds as require supports, should be staked properly, the material generally used for the purpose being split bamboo, agreeably painted green. Staking should be as unobtrusive as possible.

The essentials for success in the cultivation of annuals may be summed up as follows:—(1) Thin sowing of seeds. There is danger of “damping off” if young seedlings are overcrowded. (2) Before they overcrowd, seedlings should be promptly handled by pricking them off to pans or boxes or nursery-beds, or placing them singly in small pots or thinning them if sown in places where they are wanted to grow. (3) Overcrowding at all stages of their growth should be avoided. Plants should be placed at suitable distances apart, so that they may grow all around. (4) Supply of liquid manure and cutting away of fading flowers will prolong the blooming period considerably.

Biennials are plants which grow in one season, flower and fruit and die in the next. Generally, the period of growth is 6 to 9 months. Canterbury Bells and Scabiosa are biennials. Biennials are grown in the same way as annuals and put to similar uses.

Herbaceous perennials are those plants with soft stem, which are not shrubs in the strict sense. They are propagated

by seeds, by offsets, or by division of clumps as the case may be. Herbaceous perennials are very useful for herbaceous or mixed borders or for pot culture. Chrysanthemum, Michaelmas daisy, Solidago and Gerbera are herbaceous perennials.

Below are enumerated select annuals, biennials and herbaceous perennials. The following abbreviations are used :—

C—to denote cold season plants.

R—to denote rainy season plants.

S—to denote plants for the hot season.

H—to denote the height which the plant attains.

D—to denote the distances between plants while planting.

B—to denote the period the plants take to bloom from the time of sowing seed if grown according to the cultural notes suggested.

Achillea. (*Compositae*): Called Milfoil. Herbaceous perennial; H. 30-60 cms.; handsome feather-like, divided, graceful foliage; numerous small flowers, white or pink or yellow, borne in large compact heads lasting over a long period; easily grown from seed which germinates in 10-12 days or propagated by division; requires a sunny situation; useful for cutting.

Acroclinium. (*Compositae*): Easily cultivated, 'Everlasting' annual, producing single or double daisy-like flowers, which keep their form and colour even after they dry up. Seedlings resent disturbance and hence sow seeds where plants are wanted to grow and then thin out 10-15 cms. apart. Makes a dainty pot plant; H. about 45 cms. *A. roseum* bears pretty rose coloured flowers and *A. album*, pure white flowers. *A. grandiflorum* bears very large flowers. Suited for medium to high elevations. (C)

Ageratum. (*Compositae*). (Floss Flowers): Free blooming; H. 15-60 cms. high. Can be maintained for two seasons by frequent trimming. Useful alike for edging and for massing in beds, and for mixed borders. Flowers borne in tassel-like clusters, remaining fresh in beauty for quite a long time and hence the name, ageratum, meaning ever young. Can be grown throughout the year, as easily as a weed. Rich sandy soil gives best results. D. 25-30 cms. Should be pinched back a number of times for dwarf bushy growth. B. $2\frac{1}{2}$ -3

months. Blue shades and pure white colours are the best. Varieties, Blue Ball and Blue Cap are best dwarf blues for edging. Little Dorrit is dwarf white. Imperial Blue and Imperial White are semi-dwarfs. (R & C).

***Althaea.** (*Malvaceae*). (Hollyhock): Stately plants, one of the finest ornaments of the garden, producing large, single or double flowers, in pyramidal spikes nearly $\frac{1}{2}$ to $\frac{3}{4}$ metres long, H. 1 to $1\frac{1}{2}$ metres, the height attained depending on particular soil and weather conditions. Imposing plants for screens, borders, and for background. The double flowering kinds do not bloom in the plains but on the hills they make a splendid show; they are by nature perennials but are treated as annuals being grown from seed each time, taking about 9 months to bloom after sowing. Hollyhocks are available in several brilliant colours; the 'eyed' varieties with the centre of the flowers differently coloured from the rest of the flower, are very pretty and are becoming more popular than the 'selfs'. Seeds which are small circular discs are shown in well prepared seed-beds well enriched with manure. The seed-beds are kept moist and in a month's time, the seedlings are ready for transplanting, which should be carefully done not injuring the roots. D. 45 cms. As they require a lot of root space, should be grown in well dug rich friable soil in the ground; to prevent them from being blown over by wind, should be staked as they grow tall. B. 3-4 months from acclimatised seeds and longer from imported seeds. (R & C).

***Alyssum.** (*Cruciferae*): "Sweet Alison". Dwarf unpretending annual, 7.5 to 25 cms. high, bearing conical heads of pretty white honey-scented flowers. The blooms resemble miniature Candytufts to be effective, the plants should be grown in masses. Useful for edging larger plants in flower beds, carpet beds and hanging baskets. Broadcast seeds in light soil having a small quantity of lime in it. Thin out seedlings 15 cms. apart. B. 6 weeks. Can be sown in succession from October to January in the plains and March to June on the Hills. (C & R).

Amaranthus. (*Amarantaceae*): The Amaranthus family includes several garden species with striking foliage or blooms or both. In the foliage kinds as *A. tricolor*, *A. solicifolius*

and *A. melancholicus ruber*, the plants are hardly in need of blooms to enhance their beauty. All the species are annuals and are very easy of cultivation, requiring a deeply worked soil and sunny situation. If the soil is very rich, the plants do not colour freely. Rainy season is best suited for growing them as they need a lot of moisture as they grow rapidly and large. Seeds may be sown very thinly where the plants are wanted to grow and the seedlings thinned out later on. Or, seeds may be sown in seed beds and the seedlings transplanted, when they are sufficiently grown, at proper distances apart, in beds or borders as the case may be. They are suitable for a border of tall plants or for the centre of large beds. Very often, some species as *A. salicifolius* are attacked by red ants, which eat into the stems, injuring them irreparably. (R & S). The following are a few noteworthy species:—

* *A. tricolor splendens*. (Joseph's coat) : H. $\frac{1}{2}$ to $\frac{3}{4}$ metre ; very beautiful in borders, alone or in groups ; leaves are brilliantly coloured and variegated in scarlet crimson, yellow, bronze, and green, B. 6-8 weeks.

* *A. salicifolius*. (Fountain Plant) : Called so, on account of the thin wavy long gracefully drooping and arching leaves, which give the appearance of a fountain playing. H. $\frac{1}{2}$ to $\frac{3}{4}$ metre ornamental with a neat pyramidal habit of growth ; leaves bronzy green, changing to bright red and banded and tipped with yellow and orange ; a native of Phillippines ; makes a good pot plant.

A. melancholicus ruber : Bright red flame like foliage. H. $\frac{1}{2}$ to $\frac{3}{4}$ metre. Good for bedding or border.

A. caudatus. (Love Lies Bleeding) : Graceful, tall, robust, ornamental. H. $\frac{3}{4}$ metre. Free flowering, producing long drooping catkinlike tails of crimson or greenish white tiny flowers, nearly equal in length to the height of the plant itself, resembling an elephant's trunk. Requires rich deep soil, plenty of water and frequent supplies of weak liquid manure during growth. D. $\frac{1}{2}$ metre. B. $2\frac{1}{2}$ -3 months. (C & R).

* *Anchusa*. (*Boraginaceae*) : Pretty plants producing rich blue flowers like Forget-me-nots. Useful for mixed border or for pot culture. H. 45 to 60 cms. B. 4-6 months. D. 30 to 37 cms. Blooms in medium to high elevations only (C).

Angelonia. (*Scrophulariaceae*): Herbaceous perennial suited for growing in beds, borders and in pots, bearing pretty terminal racemes of sweet-scented bluish purple or white, showy flowers, which are irregularly two-lipped, the upper lip being two-lobed, and the lower being larger and three lobed. The plants are in bloom throughout the year; the old shoots, which have grown lanky by continuous blooming should be removed for fresh growths. Angelonias are particularly attractive in the rainy season. Propagated easily from seeds or by cuttings. *A. grandiflora* bears purple flowers and grows about $\frac{1}{2}$ metre high. A variegated variety bears purple and white flowers. * The variety *alba* bears white flowers and grows to about 45 cms. * *A. cubensis* is a comparatively dwarf plant with deep purple flowers.

* **Antirrhinum.** (*Scrophulariaceae*). (Snap-dragon): A great favourite, very serviceable as a bedding or pot or border plant. Naturally a perennial but treated as an annual and grown from seed every time. Flowers, remarkable for their gorgeous colouring in all shades of pink, rose, apricot, orange, crimson, carmine, white, yellow, mauve etc. Recently improved variegated and 'eyed' kinds, bearing large spikes of large finely shaped flowers of brilliant colours with beautifully marked throats are very pretty. H. 15 to 75 cms. Three distinct strains are available:—(a) 'tall', H. $\frac{1}{2}$ to $1\frac{1}{2}$ metres, (b) 'intermediate', H. 30-45 cms. and (c) 'dwarf' or 'Tomthumb', H. 15-22.5 cms. All of them and especially the semi-dwarf kinds are excellent bedding plants. The type of dwarfs called "Rock Hybrids" or "Magic carpet" are particularly suited for rock-work. (C).

Easy to grow, thriving in light soil, well endowed with lime. Prefer a certain amount of dryness at the roots and hence are preferably grown after the rains. Mix the fine seeds with about six times their bulk of sand before sowing to ensure uniform distribution. When seedlings are large enough to be handled, prick off 5 cms. apart in well drained porous soil in seed-pans. When about 7.5 cms. high, finally plant in beds 30-40 cms. apart or pot singly in 15 cms. pots, and shift to 22.5 cms. pots later on. Over-manuring causes rank growth and poor flowers. Liable to rot if overwatered. Pinch back

top to stimulate side growths and nip these again when they have grown 10-15 cms. Treated this way, each plant becomes a miniature under-bush and produces a number of flower-spikes, about 4 months after sowing. To keep the plants for flowering a second time, fading flower-spikes should be cut back scrupulously.

Aquilegia. (*Ranunculaceae*). (Columbine): One of the most beautiful garden plants, suited for medium to high elevations in South India. Pretty herbaceous perennials with delicate handsome foliage; suitable for growing in borders. H. $\frac{1}{2}$ - $\frac{3}{4}$ metre. Need to be shaded from afternoon sun. Bloom in the second season after sowing. Propagation can also be made by division. (C)

Arctotis. (*Compositae*). (Blue-eyed or Transvaal Daisy): Handsome with grey-green foliage. H. 45-60 cms. Bear large bluish-white, Gerbera-like flowers, well above the foliage. Flowers close at night and reopen next morning and last only for about four days and are good for cutting. Arctotis is a summer plant but it can be grown in the cold season too. It is best suited for medium to high elevations. B. $3\frac{1}{2}$ months. D. 25-30 cms. *A. grandis* is the best known species. (C).

* **Aster.** (*Compositae*): One of the most popular, showy, free-blooming annuals, very effective in beds, very serviceable as pot plants and invaluable for cutting and for making bouquets. The present-day 'Florist's' asters have been derived by a long process of evolution from a single flowered kind, introduced from China in 1731 by a Jesuit missionary. We have now asters, widely varying in habit of growth, colours and forms of flowers. There are the compact growing and the branching kinds ranging in height from 30 cms. to 90 cms. except the pure yellow, almost every conceivable shade of colour is represented in asters.

There are some well marked types or races of asters, each of them having its full range of colours. It is impossible to classify the varieties only by their stature or habit of growth, as several of the distinct types run into both tall and dwarf forms. Following are the noteworthy types of asters:—

Giant Californian Asters: Large full flowers, handsomely curled and interlaced, borne on long straight stems, $\frac{1}{2}$ metre long,

on plants reaching a height of about $\frac{3}{4}$ metre. The supergiants, Elmonte and Los Angelos, bear flowers, almost 15 cms. across.

Comet : Available in both dwarf and tall types. Flowers, double and well formed and feathery, with long narrow petals, recurved. The Crego and Ostrich Feather and the Hohenzolern asters belong to this type.

Chrysanthemum. flowered : Tall and dwarf kinds. Pretty Chrysanthemum-like flowers.

Victoria : Dwarf and intermediate types. Compact handsome flowers of neat form, covering the plant entirely.

Mammoth Peony Flowered : H. $\frac{1}{2}$ - $\frac{3}{4}$ metre. Immense double flowers, 10-12.5 cms. across, composed of numerous petals, gracefully curved towards the centre as in Peonies, borne on sturdy stems, 37.5 to 50 cms. long, quite free from laterals.

Imbricated Pompon : Charming, upright, about 37.50 cms. tall, with very beautiful small round pompon flowers, with a few rows of short broad outer petals, while the central petals, are quilled.

Branching Asters : American Beauty, American Branching (Vick's Branching), Queen of the Market, Invincible (Early Royal) and Ball Asters are excellent branching types. A typical branching aster is pyramidal in form, grows large and vigorous with many lateral branches.

Aster unicom has needle shaped petals growing to 25 cms. B. $3\frac{1}{2}$ -4 months; but Giants of California and some others take 4-5 months. All types are easy of culture requiring a well drained light porous soil. Can be grown at any time of the year at medium elevations with rainfall of about 70 cms. per year. Seedlings are to be pricked when they have about six leaves. D. 22 to 30 cms., H. 22-90 cms. Red ants, an orange coloured beetle and a larva which eats into the stem, are the chief enemies. (C).

For Perennial asters, see under Michaelmas Daisies.

Balsam. See under Impatiens.

Bartonia aurea. (*Loasaceae*). (Blazing star) : Showy bedding plant; H. 45 cms.; big Buttercup-like flowers; D. 25.5 cms.; requires open sunny situation, rich soil and plenty of water which should not stagnate at the collar of the plants; apt to rot away when coming to bloom if carelessly watered.

Seeds sown in October and plants planted out when 5 cms. high. (C).

* **Begonia.** (*Begoniaceae*): A group of beautiful popular plants, grown for their constant profusion of bloom, or ornamental foliage or both. Easily raised and easily grown pot plants. Are sub-tropical, but several species can be successfully grown at low elevations in India. Cannot survive the open sun and love semi-shady situations. Best when exposed to morning sun only. Require a rich friable well drained soil, which may consist of one part each of sand, loam, leaf-mould and well rotten horse manure, with a sprinkling of bone meal and charcoal pieces. Grown first in 15 cms. pots and then gradually shifted into 20 cms. and 30 cms. pots. Need protection from high winds.

Besides a few intermediate forms, there are five distinct classes of Begonias, namely :—

- (I) The tuberous-rooted Begonias.
- (II) The fibrous-rooted shrub Begonias.
- (III) The fibrous-rooted dwarf bedding Begonias, known as *semperflorens* Begonias.
- (IV) Rhizomatous and semi-fibrous rooted Begonias, which are mostly winter flowering.

(V) The ornamental-leaved or Rex Begonias.

* (I) **Tuberous-rooted Begonias.** These are 'bulbous plants' and are dealt with here for convenience and not under Bulbous Plants. Extremely lovely plants with tuberous roots and neat attractive foliage bearing large brilliantly coloured flowers, which are finer and larger than Roses in several varieties. The modern 'Florist's Begonias' bear many of them flowers from 10 to 15 cms. across. Several lovely shades of colour varying from the purest whites through pink and purple to the deepest scarlet and crimson, as also clear yellow, primrose, and orange shades are evolved by careful hybridization, cross-fertilization and selection. There are both single and double flowered varieties, some with plain edges, others crimped and frilled, and others again with crests on the face of the petals. They are dwarf pot plants, 30 to 45 cms. high bearing a profusion of flowers well out of the foliage. But, the 'decumbens' type has loose drooping branches and

bears pendent flowers, these merits qualifying it to be grown effectively in hanging baskets. All thrive, as a rule, from medium to high elevations only.

Tuberous-rooted Begonias are grown from bulbs usually imported from Holland, Australia, England and Germany. The tubers are started into growth by placing them in a layer of damp moss or sand with the concave side up. They soon show signs of growth and sprout. When the sprouts are about 1.5 cms. long, each tuber is planted in a 22.5 cms. pot, using the compost recommended above. To prevent it from rotting away and to facilitate rooting, the tuber is best placed in a layer of sand all round it, and covered lightly with a portion of stem visible over the soil. Till growth starts vigorously, watering has to be sparingly done. Weak liquid manure-cow-dung water—is given once in ten days, when it is growing till commencement of flowering. The plants are sheltered from strong sun and wind; they bear flowers from August to October. Then, water supply is gradually reduced. They lose their foliage. Then the pots are removed to a cool dry place for resting the tubers till the next potting season in April or May, in Bangalore.

Tuberous-rooted Begonias are also raised from seed. One can raise a number of plants from a pocket of seeds, though a certain percentage of them bear only single and yet pretty flowers. Seeds are very minute and almost dust-like. They are sown with the usual care taken in sowing such fine seeds, in seed-pans. (See pages 64-68), 2 to 3 months earlier than the time for potting tubers, that is, January in Bangalore. The seedlings are very tender and they damp off if overwatered. When they are fit to be handled with ease, when the seed leaves are well developed, they are pricked 1.5 cms. apart in porous light soil. They are carefully watered with a special very fine rosed water-can, or better still, the pans may be watered from below, as described in page 67 till the plants can be safely watered from above. The pans are protected from strong sunshine. By the end of March, the plants are large enough to be potted separately in 7.5 cms. pots. The plants require to be watered carefully as before. When the roots have filled the pots, they are shifted on to 15 cms. pots, without disturb-

ing the balls of earth attached to the roots. Thereafter, they are treated as plants growing from tubers. As the plants grow, they form tubers under the seasonal stems. By July-August, almost all the plants will be in bloom.

(II) **Fibrous-rooted shrub Begonias:** Herbaceous shrubs of varied habit of growth; some are dwarf and shrubby, not growing more than $\frac{1}{2}$ metre high; others grow as tall $1\frac{1}{2}$ metre, producing canelike stems, carrying flowers. The foliage is usually dull or bright green. There are some hybrids however with very prettily variegated or coloured foliage. Most species flower throughout the year; some bloom but once a year in winter between January and March.

Most species produce sterile flowers and hence propagation is mainly from cuttings. Insert into a 15 cms. pot by the edge, 4 to 6 terminal cuttings, about 12.5 cms. in length using a mixture of 4 parts of pure sand and 1 part of leaf-mould as the medium for rooting. After the cuttings have rooted, which is indicated by top growths, pot each cutting separately in a 15 cms. pot. Shift the plants to bigger pots, as the pots are filled with roots. Several species of shrub Begonias take one to two years to make full-sized specimens. Most species may be content with 24 cms. pots while some require larger pots for forming specimen plants. It must be emphasised, however, that Begonias should never be grown in pots too big for them. The roots should not be injured during any of the shifts. Anxious and desirous of making a large number of plants from one good shrubby specimen, some tear up the plants into pieces and pot them separately. Very often, the whole lot of them die. Batches of cuttings put in at intervals 4-6 months ensure new and handsome plants. As the shoots lengthen and grow, they should be neatly tied to a stake or stakes. The plants should be fed with weak liquid manure of cow dung once a fortnight. The old canes which have finished flowering, should be cut away and used for propagation.

The following are some of best shrub Begonias:—

**B. corallina* (coral flowered): One of the handsomest species, with ovate-oblong, pointed, dull green leaves, which are spotted grey when young. Bears numerous long pendent racemes of bright coral-red flowers tall canelike shoots, which

grow sometimes $1\frac{1}{2}$ -2 metres. There is a handsome variety of the above, bearing pale white flowers, which are slightly smaller in size.

* *B. gigantea rosea*: Another splendid kind, probably a hybrid between the *semperflorens* type and *B. coccinea*; leaves are roundish, brightly polished, very large, thick and handsome. The plant has a sturdy habit of growth with side branches, all the shoots being surmounted by large erect clusters of bright rose coloured flowers. Sappy terminal cuttings, 5-7.5 cms. long, make the best plants. H. $\frac{1}{2}$ - $\frac{3}{4}$ metre.

* *B. President Carnot*: Showy species, bearing very large clusters of deep red flowers, hanging down the ends of the shoots. A hardy species, which does well even in the plains. H. $\frac{1}{2}$ - $\frac{3}{4}$ metre.

* *B. President Carnot variety rosea*: Upright habit of a growth, bearing very pretty deep rose coloured flowers in large clusters, which stand out of the foliage prominently. A very pro-use flowering attractive hardy plant. 1 metre.

* *B. ornata* is white flowering; like *President Carnot*: H. $\frac{1}{2}$ metre.

B. maculata is of similar habit as the above species. The foliage is variegated and blotched with silvery grey and pink dots and patches. The flowers are pink in colour and do not appear much, as they do not contrast well with the foliage.

* *B. Glorie de Seaux* (?) is very pretty plant, with neat attractive foliage, which is variegated by dots of pink, green and purple. Bears bunches of pink flowers. Both the flowers and the foliage are attractive. H. $\frac{1}{2}$ metre.

B. manicata: There are two hybrids with white or rose coloured flowers, borne in loose clusters, much above the green foliage. Very free flowering and desirable. H. $\frac{1}{2}$ - $\frac{3}{4}$ metre.

* *B. Ingramii* makes a good dwarf bush, bearing pink flowers. Suitable for hanging baskets and growing in urns.

* *B. fuchsoides* is a pretty shrub with comparatively small leaves, bearing fuchsia-like coral red flowers, in clusters from the ends of branches. $\frac{1}{2}$ metre.

B. echinosepala is a very pretty white flowering variety.

B. lobullata is a large coarse shrub with tall stems and large roundish leaves, bearing pale white flowers in erect large

clusters. Flowers only once a year in winter.

B. weltoniensis; *B. Haageana*; *B. ulmifolia*; *B. argenteo guttata*; *B. luxurians* are some others, which are handsome. The silver and pink and purple variegated leaved hybrids are very attractive and they are grown more for their foliage than flowers.

* (III) **Semperflorens Begonias**: Dwarf, compact, free flowering plants, not attaining more than about 30 cms. in height. They make lovely pot plants; they are also valuable for edging beds and borders. They are called "Bedding Begonias", as they can be successfully grown in beds making a good show for a good length of time. They are a hardy class, thriving well even at low elevations; the red flowered varieties do not seem to stand the hot climate of the plains of S. India as the white flowered kinds. The best season for cultivation in beds is between November and February. In the hot months, the plants should be taken out of the beds and potted firmly and removed to a semi-shady cool place. Propagation is from cuttings or by division of clumps or from seed. New plants should be raised every year to replace old ones. Put half a dozen cuttings (do not choose very soft and tender ones) 10-15 cms. long, in a 15 cms. pot in sand to which a little leaf-mould is added. Water carefully and keep the pot in shade in a cool place. After the cuttings have struck roots cut the top ends a little to hasten the formation of more fresh roots and to force the plants to throw out shoots from under the soil. When the pot is full of roots transfer with the ball of earth undisturbed to a 22.5 cms. pot. Do not allow the plants to flower till they have grown enough to cover the pot. Feed with liquid manure of cow-dung water, during period of active growth. The plants continue flowering, crowned with a mass of flowers, for nearly three months. The duration of blooming period is lengthened, by removing seed pods systematically, which also keeps the plant clean. When blooms are past and the plants have lost much of their beauty on account of the continued growth of the shoots which with age become bare and ugly, shift the plants from 22.5 to 30 cms. pots and cut away the ugly shoots. In 3-4 months more, the plants throw out new suckers and shoots and become new

plants for all practical purposes.

(IV) **Semi-fibrous-rooted rhizomatous Begonias:** This class includes some attractive species as *B. nelumbifolia*. They are characterised by having thick creeping underground stems and large leaves with long stalks. They mostly flower in winter. Flowers are produced freely in long loose sprays. Some of the kinds are very hardy and thrive in the plains even in exposed situations. They are suited for growing on rockeries. Propagation is made by cutting the creeping stem into 2.5 cms. bits and inserting them in sand. Terminal cuttings also strike roots and make good plants.

B. nelumbifolia has large roundish thick light green leaves, resembling those of the lotus (hence the name) and bears pale pink flowers in plenty, crowded in long erect sprays. Makes an excellent pot plant, the large leaves covering the sides of the pot and the flowers making quite a good show above the handsome foliage. Does very well in the plains.

B. discolor has brownish foliage and bears erect attractive sprays of pink flowers. Does well as a pot plant. Suited for growing on rockeries too.

*(V) **Ornamental - leaved or Rex Begonias:** Foliage plants, treated here for convenience. One of the most handsome foliage plants, suited for pot culture and for rockeries for places above 500 metres. They are dwarf, 15-30 cms. high, rhizomatous perennials with foliage beautifully striped and blotched with different colours. They retain their beauty throughout the year, but, they make comparatively little growth in the winter months. Rex Begonias do not thrive in the plains but they do respond to good cultivation inside conservatories. They do best under a glass roofing failing which, when kept away from direct sunlight, in moderate shade, in a comparatively moist atmosphere, as in conservatories. To the compost recommended generally for all Begonias, some brick and charcoal pieces are preferably added for better drainage. During the period of least growth, they should be watered carefully, never giving them more water than necessary to prevent them from shrivelling up. Propagated by seeds, leaf cuttings, and by division of the old plant. From seed, they are grown in much the same way as tuberous-rooted Begonias. For a cutting,

the centre of the leaf with 2.5 cms. of the stalk attached to it, is best, as this forms the best plant. But, any place, where two large veins meet, will strike root, if cut there and kept pressed into moist sand. The pan containing the cuttings is to be kept in a shady place and watered carefully, just keeping the soil moist. Young plants are developed and emerge out of the soil. These are potted separately in 7.5 to 10 cms. pots using light soil and shifted to 22.5 cms. pots later on. Flowers are removed as they weaken the plant if allowed to seed. There are several varieties of Rex Begonias.

Bellis perennis. (*Compositae*). (Perennial Daisy): Handsome perennial of dwarf habit of growth; H. 15-22 cms.; double and single flowers in white, pink and crimson shades of colours. Plants from seeds are preferable to those raised from suckers, being more floriferous and vigorous in growth. Young plants are potted when 5 cms. high in 15 cms. pots or transplanted 15 to 22.5 metres apart. Finally shifted from 15 cms. to 22.5 cms. pots. Soil used should be light and rich. Daisies like a situation shaded from severe afternoon sun. They are useful for small beds or for edging or for pot culture; may be grown on rockeries. Not well suited for low elevations. B. $3\frac{1}{2}$ - 4 months. (C).

Brachycome iberidifolia. (*Compositae*). (Swan River Daisy): Delightful hardy annual of dwarf growth, 15-25 cms. high, with finely divided foliage, bearing in profusion pretty star-like blue or white or rose coloured, daisy-like flowers. Well suited for small beds, floral edgings, herbaceous border or for pot culture. Seedlings do not transplant well and hence sowing should be done *in situ* and the seedlings thinned out 15 cms. apart. B. $2\frac{1}{2}$ months. (C).

Browallia. (*Scrophulariaceae*): *B. elata* is one of the most easily grown, pretty, free blooming annuals. H. 30-45 cms. A profusion of delicate blue or white flowers are produced in less than 3 months after sowing. They are effective only in masses in large beds or borders. D. 20-25 cms. For bushy growth, the plants should be pinched back frequently. *B. speciosa* is a better species which is rather uncommon with large attractive blooms of a deep violet colour. This species makes a showy pot plant too. It is propagated by cuttings

inserted in sand and potted off as soon as new roots are sufficiently formed and established. Plants may also be easily raised from seeds to flower in 4 months. Thrives better, if protected from severe afternoon sun. *B. speciosa* var. *major* is one of the finest and largest flowered *Browallias*. Propagated from seeds; repot young plants from time to time and do not allow them to get pot bound. (C).

Cacalia. (*Compositae*). (Tassel Flower): Also, known as Flora's Paint Brush. Grows like a weed without care. Useful in the border, producing small tassel-like flowers of orange, scarlet, yellow and white colours. Height 37.5 cms.; D. 22.5 cms.; B. 10 weeks. (R & C & S).

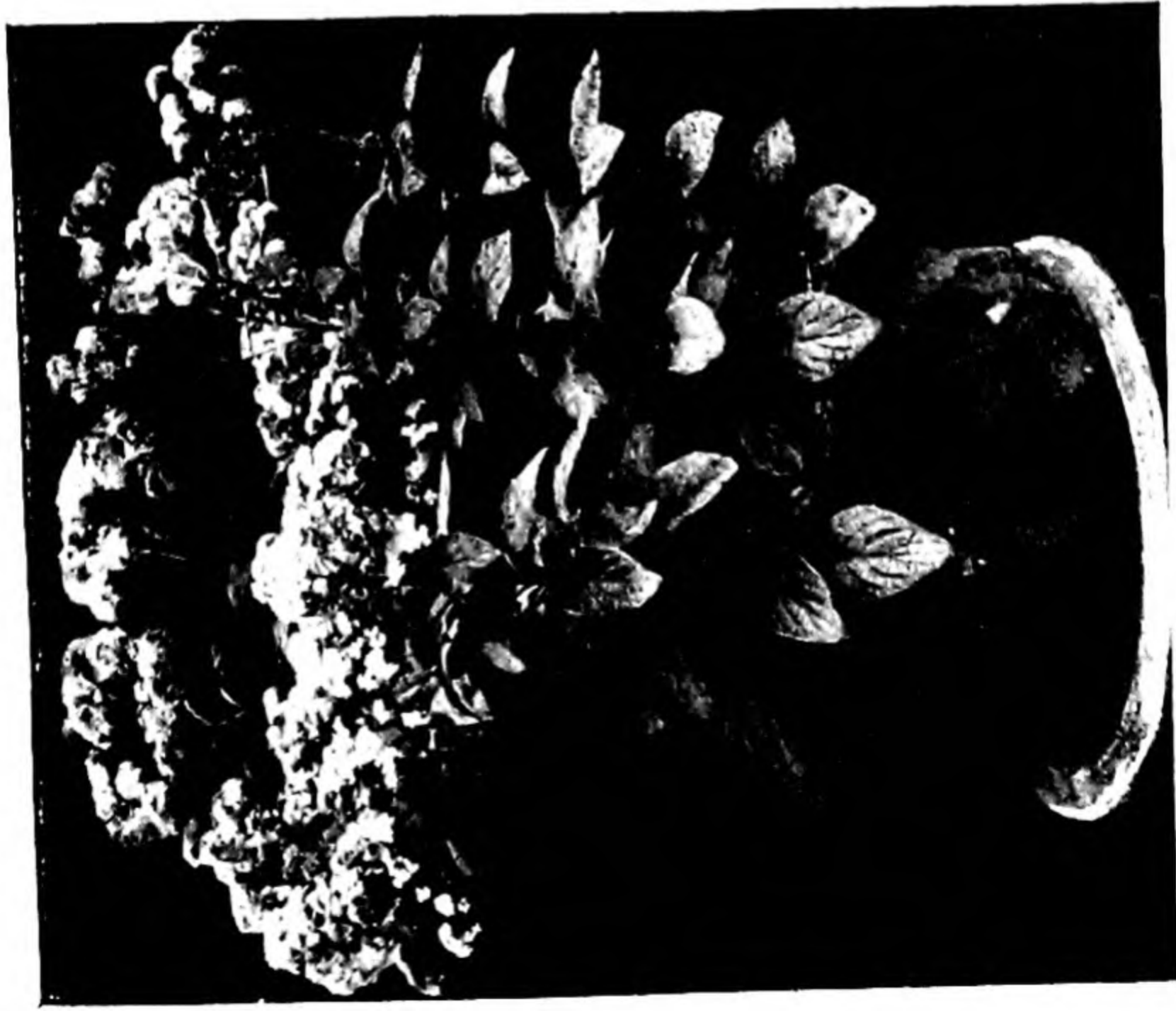
Calceolaria. (*Scrophulariaceae*): One of the most beautiful plants remarkable for its gorgeously coloured peculiar flowers, which resemble circular pocket purses. Flowers are borne in wonderful profusion, making a gorgeous display of colour in all shades and blotches of different colours. Essentially a pot plant fit for culture in green houses. Cannot be grown with any degree of success in the plains. Thrives well on Hill stations. At medium elevations, only *Calceolaria pinnata* does fairly well. Seeds are very small and hence need to be sown with the usual care exercised with such seeds. When seedlings form 4-6 leaves, they are pricked off into small 10 cms. pots in a light soil composed of a large quantity of sand and leaf-mould. The plants are later shifted on to 22.5 cms. pots using a slightly richer compost than before. For bushy growth, the plants should be stopped a number of times before flowering. Careful watering and protection from strong sunshine are absolutely essential. H. about $\frac{1}{2}$ metre. B. 8-10 months. (C).

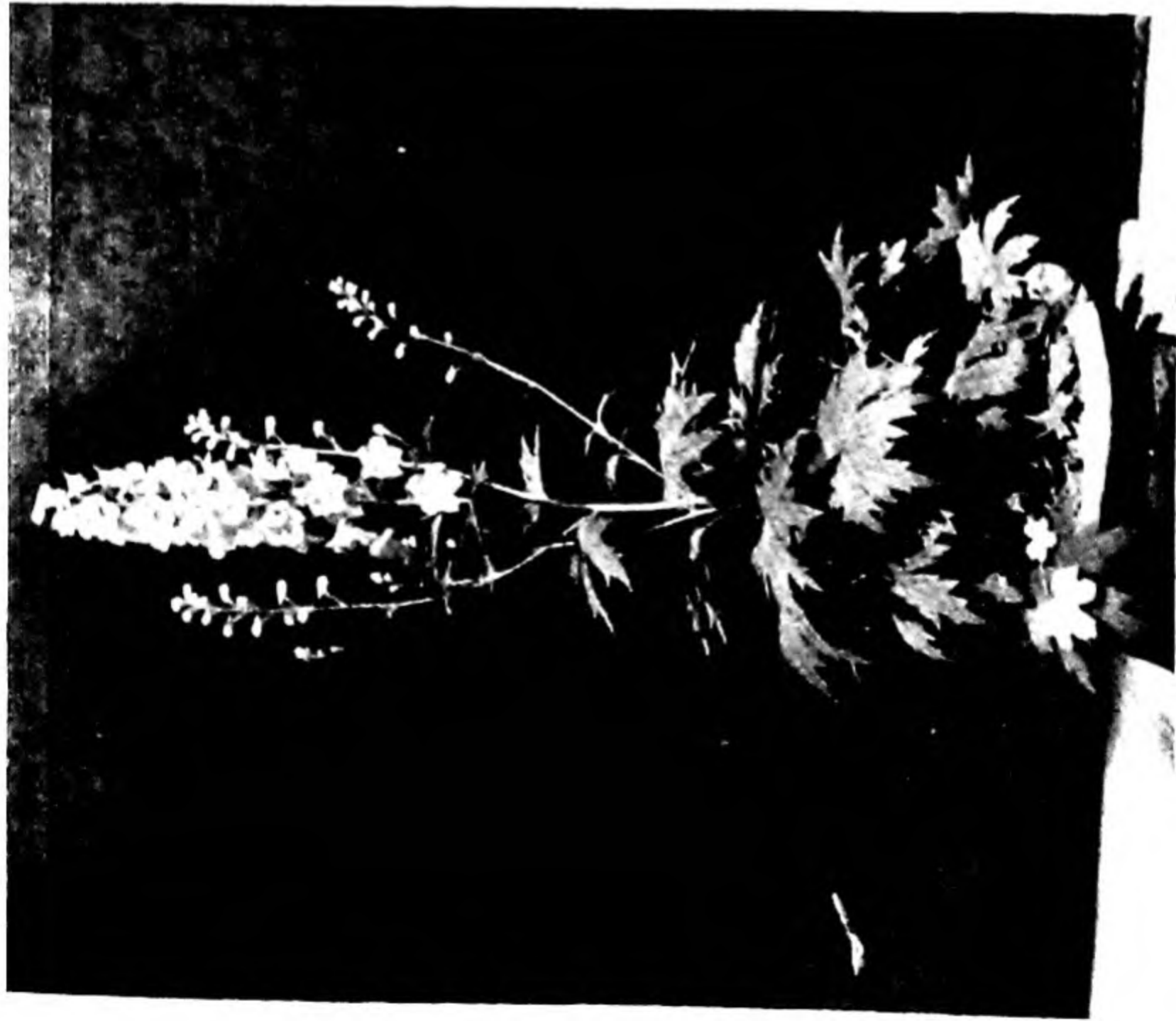
* **Calendula.** (*Compositae*). (Pot Marigold): Free flowering annual of easy culture, succeeding in any good soil and blooming continuously for nearly 2 months. H. about 30 cms. There are many varieties, with single or double flowers, varying from straw colour to deep orange, and often measuring 4-5 cms. across. Imported seeds do not germinate well except in the cold season and hence it is advisable to save seeds for future use by tying a piece of muslin over the flowers, after they are well past their age, so that the seeds

PENICILLION

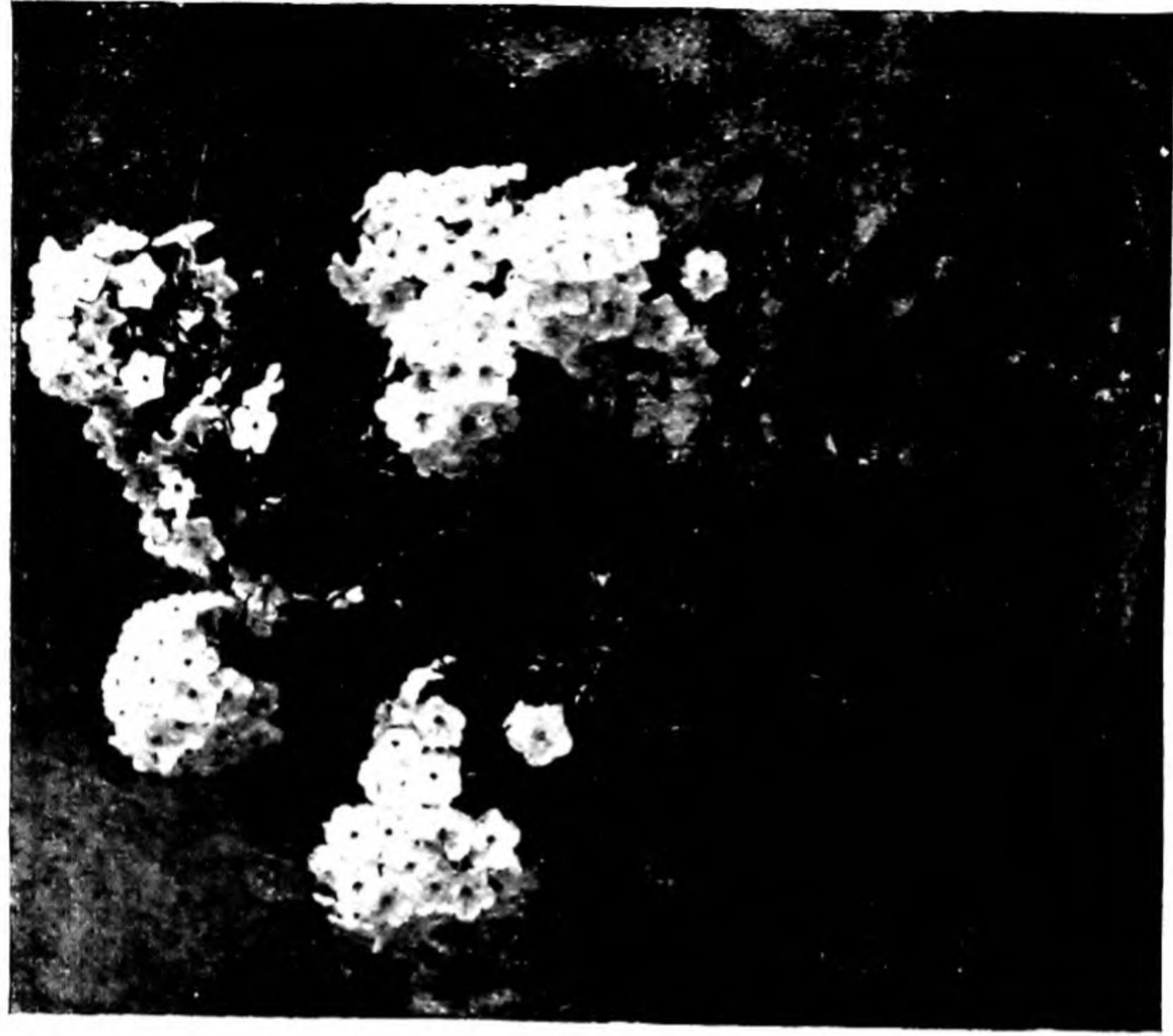


HELIOTROPE





DELPHINIUM



PERENNIAL PHLOX

may not drop off on ripening. Seedlings do not transplant well and hence seeds should be sown where they are wanted to grow. D. 30 cms. For pot culture, pot the seedlings when they are about 5 cms. high, without injuring the roots, in 22.5 cms. pots. B. $2\frac{1}{2}$ -3 months. The blooming period is very much prolonged by regularly cutting away old blooms. Thrives well in places with heavy rainfall too. (C & R).

* **Calliopsis.** (*Compositae*). (*Coreopsis*): One of the most free flowering hardy showy annuals, producing flowers in great profusion, which are poised over their long stalks well above the foliage, which in many kinds is very handsome being beautifully divided or feathery. Flowers are single or double, and in yellow, bronze, orange and crimson colours. Excellent for borders. Do better in the ground than in pots as they require a lot of room for their roots. Sow seeds in pans or seed-beds and when the sixth leaf appears on the seedlings, transplant them 30-45 cms. apart, the distance depending upon the height to which the particular variety grows. H. $\frac{1}{4}$ to $\frac{3}{4}$ metre. B. 4 months. *C. Drummondii* is a dwarf variety, H. 20-40 cms. producing bright golden yellow flowers with bronzy red centre, in endless profusion. *C. grandiflora* yields brilliant yellow flowers shaded orange. A perennial, H. $\frac{3}{4}$ metre. A shy bloomer in the plain. *C. tinctoria* bears dark crimson flowers, H. $\frac{3}{4}$ metre. *C. coronaria* is another good species, a late bloomer. All are good for cutting. *C. Sultan* is a dwarf kind, H. 22.5 to 30 cms. bearing hundreds of crimson and maroon flowers in a thick compact little plant. (RSC).

* **Campanula.** (*Campanulaceae*). (Bell Flower): Large genus consisting of annuals, biennials and perennials of varying size and habit of growth, producing characteristic large cup or bell-shaped flowers of imposing beauty. H. 45 to 90 cms. The usual colours are blue, mauve, pink or white. Flowers are single or double. Campanulas thrive best in hill stations and some kinds can be tried with success at medium elevations. B. 8-9 months. Pot seedlings when fit to be handled in small 5.7 cms. pots and transfer to larger pots with increasing growth. Partially shaded position desirable. *C. pyramidalis* and *C. media* are well known species. The *Annual Canterbury*

Bells, grow $\frac{1}{2}$ metre tall, and flower in less than six months from the time of sowing; the form of the plants and the shape of the flowers are the same as in the perennial species. May be grown in the cold season at low to medium elevations. (CR).

Candytuft. See under *Iberis*.

Carnation. See under *Dianthus*.

Celosia. (*Amarantaceae*): Popular pretty garden annuals, which are grown for their agglomerated large flower heads; easy of culture, thriving in rich deeply dug soil, with a liberal supply of water; very effective in flower beds or borders, the blooms lasting for more than two months. (R. S. C.). There are several types, the following being noteworthy:—

* *Celosia cristata* (Cockscomb): A charming annual, for culture in pots and in borders; H. 22.5 to 60 cms. A large compact velvety head of yellow, crimson, purple or other colour, sometimes as large as a child's head measuring 30 by 20 cms. is borne well above the foliage. Grow dwarf kinds in 22.5 cms. pots and intermediate and tall kinds in long borders. Can be grown throughout the year. Sow seeds in seed-pans and prick the seedlings when they have half a dozen leaves. For pot culture, pot singly in 10 cms. pots. Retain only plants which form good cobs and when they grow, transfer to 22.5 cms. pots. D. for dwarf kinds, 22.5 to 30 cms. for tall kinds, 30 to 45 cms. Apply liquid manure once in ten days. B. 3 months; tall giant varieties take 4 months. The new super giant tall strain of cockscomb introduced to the horticultural public by the author in the Flower Show at Bangalore in 1921 and popularised since then takes $4\frac{1}{2}$ to 5 months to develop its mammoth heads on tall vigorous stout stems.

* *Celosia plumosa*. (Feathery Cockscomb): H. $\frac{1}{4}$ to $\frac{1}{2}$ metre; of a branching habit of growth, unlike the preceding type, producing large plumes of more or less pyramidal form resembling ostrich-plumes, very effective in beds, can be successfully grown in 30 cms. pots. The plumes often measure 30-45 x 20 cms. D. 45-60 cms. B. $2\frac{1}{2}$ months.

* *Celosia Childsii*. (Chinese Wool Flower): A unique type of preceding species. The plant is of the same habit of

growth as *C. plumosa* but bears woolly globular heads of the size of tennis balls at the ends of the several shoots. H. $\frac{1}{4}$ – $\frac{1}{2}$ metre. The commonest colour is carmine but the pink, white and yellow are now available. B. $2\frac{1}{2}$ months.

* **Centaurea.** (*Compositae*): The two species which are commonly grown are *C. cyanus* and *C. moschata*. The former is popularly known as the Corn Flower or the Blue-bottle and the latter as the Sweet Sultan. Corn Flowers are showy annuals, H. 45 to 60 cms. B. $3\frac{1}{2}$ months, flowering in great profusion. The colours are blue, pink, rose, lilac, white and purple. The flowers with their long stalks are very useful for cutting. Do not flower as freely in the plains as at medium elevations. Broadcast the seeds and thin out 22.5 cms apart. Watering should be sparingly done.

The Sweet Sultan, H. $\frac{1}{2}$ metre; bears very pretty thistle-like, delicate-looking, delightfully scented flowers, which are white, mauve, lilac, purple or yellow. The soil should be light and rich and well drained; liable to rot if overwatered. Sow in seed-pans and very carefully transplant when the seedlings are 5 cms. high; the roots are very delicate and liable to break by careless handling; or broadcast seeds and thin out 30 cms. apart. More difficult to grow than Corn Flower. B. 3– $3\frac{1}{2}$ months. * *C. imperialis* (Royal Sweet Sultans) bear improved large sweet scented flowers exquisitely frilled. H. about 1 metre. (C).

Cheiranthus. (*Cruciferae*): (Wall Flower; Gilliflower). Small shrubby biennials and perennials, growing $\frac{1}{4}$ to $\frac{1}{2}$ metre high producing flowers like Stocks. They do not bloom satisfactorily at low and medium elevations. Soil should be light and contain lime D. 30–45 cms. (C).

* **Chrysanthemum.** (*Compositae*): (Tamil: 'Javanthi'; Canarese: 'Savantige'). Both perennial and annual species. Flowers are single or double, available in attractive colours and useful for cutting. In Indian gardens, one is accustomed to find only the perennial species, bearing profusely, comparatively small, highly scented, yellow or white flowers, which are used for puja purposes and by Hindu ladies for garlands and head-dress. These perennial small flowering kinds are very extensively grown in large fields by market gardeners to meet

the demand for flowers during the Gouri-Ganesh and the Dasara festivities. Fields of these Chrysanthemums, when in full bloom present one of the grandest floral sights.

Annual species: Useful in the mixed border, for bedding and for pot culture; thrive in open sunny situations; grown with comparatively little care. (C). The following annual species deserve mention:—

C. carinatum=tricolor, known as the Summer Marguerite is very handsome with its elegantly cut foliage and pretty daisy-like three-coloured flowers, which measure 10-12.5 cms. across; they have a dark eye surrounded by a narrow yellow ring, then slightly scarlet or crimson ring, followed by the dominant colour of the variety. Raised from seeds. H. $\frac{3}{4}$ metre. B. $3\frac{1}{2}$ -4 months. D. $\frac{1}{2}$ metre.

C. coronarium, called the Crown Daisy, is of a more branching habit of growth and less finely cut foliage than the preceding species. Flowers are single or double and are white or yellow or orange coloured. A certain proportion of plants raised from seeds produce single flowers. H. $\frac{3}{4}$ metre.

Perennial species: Of the perennial species, the following deserve mention:—

C. maximum and its varieties (Ox-Eye Daisies) are hardy herbaceous perennials, growing 45-70 cms. high. They have glossy green, leathery, toothed leaves and bear showy white flowers with an yellow centre, measuring 6-7 cms.

* *C. leucanthemum grandiflorum* (British Ox-Eye Daisy) bears large white flowers. About $\frac{1}{2}$ metre high.

The Shasta Daisies are charming American hybrids from *C. leucanthemum* and *C. maximum*; they are dwarf compact bushes covered with snowy white flowers nearly 10 cms. across, produced in great abundance.

All the above mentioned perennial species thrive only at medium to high elevations. They are propagated by division of the old plants and also from seed.

C. frutescens (White Paris Daisy or the French Marguerite) is a small shrubby plant, $\frac{1}{2}$ metre high, with finely cut silvery foliage and bearing single, daisy-like white flowers. A charming plant for pot culture or for growing in beds or borders. Easily raised from cuttings. Suited for medium to high elevation.

* *Florist's Chrysanthemums*: are varieties and types derived mainly from *C. hortorum* and *C. indicum*. Flowers are largely double—there are several attractive single flowering kinds also—often measuring 15-22.5 cms. across. The colour, form, and the arrangement and the shape of the petals vary widely. While some varieties are scented, others have but little fragrance H. 37.5-60 cms. There are numerous named varieties.

Generally, Florist's Chrysanthemums fall under one of the following types or classes:—(a) Incurved. (b) Reflexed. (c) Japanese. (d) Pompon. (e) Anemone. (f) Rayonnante. (g) Singles and (h) Miscellaneous Fancy kinds as the spidery, plumed and feathery kinds of a fanciful character. The shape and form of flowers and arrangement of petals form the basis for classification. In the incurved type of flower, the petals are turned upwards and away from the flower-stalk and curve inwards so that they form a globular head of regular outline. In the reflexed type, the petals are turned back and downwards towards the flower-stalk. The Japanese class includes a wide range of form, size and colour and it is very popular. In this type, the flower is highly irregular, being in utter contrast with the two preceding types; the petals are tossed about wildly in every direction in charming dis-array, though on the whole the flower is globular or nearly globular. The Anemones are distinguished from all the above types in having a high, neatly formed centre of close petals, almost like a Sun flower, but still more like an Anemone, surrounded by a fringe of large loose petals. The Rayonnante and its forms offer a distinct pretty type with tubular petals, making light and graceful blooms; the Rayonnante has greater resemblance to the Cactus-flowered Dahlia than any other Chrysanthemum. The single and semi-double kinds have one or two rows of petals with a large disc in the centre.

The Cascade Chrysanthemums grow only 22.5 cms. tall with trailing stems bearing multitudes of small flowers. They are eminently suited for growing in hanging baskets. *The Korean Chrysanthemums* grow 22.5 to 45 cms. and tall bear single or double or semi-double small flowers in large clusters. One need not take the trouble of growing Cinerarias if

equipped with varieties of these, which are available in a great range of colours. Both the above types are easily grown from suckers or from seeds.

Chrysanthemums can be propagated in three ways :—(1) By suckers taken out of old plants. (2) By cuttings. (3) From seed. Propagation from seed is seldom resorted to unless new varieties are desired to be grown. Propagation by cuttings is the best method. Plants raised from cuttings are neater and sturdier than those grown from suckers. Hence, the first step in the cultivation of Chrysanthemums is to secure good healthy cuttings. Plants of the preceding year which have finished flowering, afford good stock from which to propagate the following season. After flowering is over, the soil in the pot is top-dressed with a rich mixture of manure and loam and the stem which has finished flowering is cut back to the soil level. The plant is well taken care of with regular and liberal supplies of water and is kept in an open sunny situation. In few days, sappy short sturdy suckers or 'stools' as they are called, are produced. Growths that come up around the base of the stem make the best cuttings. When the suckers are 15 cms. high, stout terminal cuttings, 10 cms. long are taken from them. The lower leaves of each cutting are removed and the upper leaves are shortened in length. The cuttings, thus prepared, are potted in porous soil made up of equal parts of well rotten sifted leaf-mould and sand in seed-pans or nursery beds. In Bangalore and Madras, Chrysanthemums are timed to flower early in the months of August and February respectively. For this purpose slips are started for rooting, about six months before the blooms are wanted. As soon as the slips are rooted well and are growing, they are potted off singly in 12.5 cms. pots in fairly rich soil (Compost No. 1, page 126). As growth progresses, the plants should be copiously watered. When the roots fill the pots, the plants are shifted to 22.5 cms. pots. After the plants are well established, plenty of water and full sunshine should be given to them. The best plan to reduce the height of the plant to a minimum is to 'pot-hard' them, that is, press the soil firmly around the plant, and to keep the plants far apart without over crowding while growing.

Chrysanthemums require a liberal supply of water and there is little danger of overwatering them. So long as the foliage is bright green, they may be considered to be quite healthy. If it turns yellow and sickly, it is a sign that the drainage is not alright.

Chrysanthemums are gross feeders and hence for large blooms, weak liquid manure usually prepared from pongamia oil cake is applied once a fortnight. No fixed rule is feasible regarding feeding. Very often, the look of the plant is a safe guide. The limit of feeding can be said to be reached when the leaves are dark green and have become brittle. In some varieties, overfeeding leads to refusal to bud, the plant going into leaf. Again, in some others, overfeeding results in distorted and misshapen buds and flowers and in the 'burning' of the core of the flower head.

Suckers are to be removed as they come up, as they grow at the expense of the parent plant and rob the soil of much of its nutritive contents. The plants are staked and trained from the stage they are about 22.5 cms. high. All lateral growths from the stem are removed, only retaining shoots which are to flower. For large show-blooms, plants are restricted to a single stem and flower. For garden decoration, the popular type of a pot-plant is a compact bushy plant, $\frac{1}{4}$ to $\frac{1}{2}$ metre high, branched at the base and bearing 4 to 20 flowers, averaging 7.5 to 10 cms. across. This kind of bushy specimen is obtained by pinching the top of the plant when it is about 15 cms. high and allowing the lateral growths to come up. The buds on these shoots may be thinned out for larger blooms if desired. Single flowered kinds, if grown bushy look like Cineraria blooms.

In the cultivation of Chrysanthemums for exhibition, the whole energy of the plant is utilised to produce only one or two blooms by recourse to disbudding. In growing large flowered show-kinds, one has to note the difference between the crown and terminal buds. When a plant is grown to a single stem, it produces first, one single bud (the crown bud), which never comes with other buds. Below the crown bud are a number of lateral growths, which if allowed to remain, will continue their growth and produce terminal buds later on.

The crown bud is largest in size and with the removal of the lateral shoots under this bud, disbudding is complete. But, it is to be noted, that very often and in the case of certain varieties invariably, the crown bud results in a coarse, though large flower. If that is the case, terminal buds give better blooms. Terminal buds come up later than the crown bud, in clusters and are not associated with lateral growths as the crown bud. If flowers are to be had from terminal buds, the crown bud is removed and one or two or three of the lateral growths just under it are retained, according to the vigour of the plant. At the apex of or in the centre of each cluster of terminal buds will be noticed a large bud, which is usually perfect and is saved, while the others are rubbed off.

When the buds are half open, it is advisable to shelter them from severe afternoon sun. At this stage care is to be taken not to wet the petals of the flower.

Pests and diseases to which Chrysanthemums are mainly liable to are (i) the Cockchafer grub, (ii) Aphis, (iii) Caterpillars, eating leaves, (iv) Rust, and (v) Black spot. For remedies, see under the respective headings in Chapter XI.

In summing up, it may be mentioned, that with careful selection of sturdy cuttings, generous culture throughout the growing season, close attention to watering, feeding, removal of suckers, staking and disbudding, and keeping the plants free from diseases and pests, one is assured of the lovely large blooms, which well repay the trouble taken over a period of about six months. (R & C).

* **Cineraria.** (*Compositae*): Beautiful pot plants for the conservatory. Very showy with their large luxuriant leaves which are surmounted by immense panicles of magnificent flowers of most brilliant colours. Blooms last for quite a long time—for nearly a month. H. $\frac{1}{4}$ to $\frac{1}{2}$ metre. There are two types, the Florist's or Grandiflora type and the Stellata or the Star type. The latter class is very popular nowadays. The former are dwarf growing and bear solid masses of large flowers. The latter type grows taller, to about $\frac{1}{2}$ metre, has smaller leaves, has smaller individual flowers but more numerous than in the grandiflora type; and the rays or the petals are separated as in Michaelmas Daisies. Cinerarias cannot be

successfully grown in the plains. They do well at medium elevations in the cold season.

Cinerarias are grown annually from seed, though they may be raised from cuttings taken from old plants. Seeds are very small and sown with all the precautions to be taken in sowing such seeds. (See pages 66-67). 'Seedlings are pricked' when they show the first rough leaf. When they are large enough to be handled with ease, they are potted in small 7.5 cms. pots in a soil composed of 2 parts each of well sifted leaf-mould, fine silver sand, and 1 part each of red earth and well rotten powdered horse manure. The pots are removed to a shady situation and given only morning sun after they are established. As the plants grow and develop more roots, they are shifted to 15 cms. and finally into 22.5 cms. pots, using Compost No. 1, page 126. Shelter from wind, plenty of good air, only morning sun, careful watering, occasional feeding with liquid manure (weak cow dung solution), are important points to be attended to in the cultivation of Cinerarias. Frequent overhead sprinklings with clear water benefit them immensely. At medium elevations, the plants flower but once and die but on the hills, they can be cut down to 2.5 cms. from the surface of the soil and top-dressed with fresh compost to flower a second time during the following season. Usually, for exhibition purposes, only one bunch of flower is grown on a plant. Mildew, aphides and thrips are the greatest enemies of Cinerarias; bad cultivation and overcrowding usually bring on mildew. Aphides and thrips are easily eradicated by spraying with weak tobacco water. B. $4\frac{1}{2}$ -5 months. (C).

* **Clarkia.** (*Onagraceae*): One of the most showy but delicate annuals, but succeeding well at low elevations. H. $\frac{1}{4}$ to $\frac{1}{2}$ metre. Bears very handsome flowers of pink, white, magenta and red in several shades, in long spikes, which are useful for cutting. Clarkias are effective in beds and borders in masses but they are usually grown in 25 cms. pots, keeping three to five plants in a pot. Seedlings do not transplant well. Hence, the seeds are sown where the plants are to flower and thinned out 15-20 cms. apart, when 7.5 cms. high. They do not stand much moisture and they should necessarily

be protected from exposure to rains. They need pinching back twice or thrice for bushy growth. B. $3\frac{1}{2}$ months. *Clarkia elegans* and *C. pulchella* are the favourite species. (S.V.)

Cleome. (*Capparidaceae*). (Spider Flower): Stately annuals, forming neat attractive bushy plants, bearing freely, erect clumps of queer-looking flowers well above the foliage, consisting of large digitate leaves, which are seven-lobed and are carried on long stalks. H. $\frac{3}{4}$ to 1 metre. Flowers are very interesting, consisting of four showy petals and long slender stamens and stigma so wonderfully arranged that they have the appearance of spiders, hence the common name, Spider Flower. There are varieties, bearing pure white or pink or rose coloured. Seeds are borne plentifully on long slender pods borne on long slender stalks. They should be soaked in water for at least three hours before sowing to insure quick and uniform germination. B. 3 months. Flowering continues for nearly a month and a half. Cleome thrives in a deep rich soil and likes to be watered copiously during the period of vigorous growth. Pot singly in 25 cms. pots or grow in ground 45-60 cms. apart. Very useful as a background for floral borders and for circular beds cut out on lawns. (S.R.)

Cobaea scandens. (*Polemoniaceae*). (Cup and Saucer Vine): One of the most beautiful annual climbers in cultivation. Can grow up to 4 metres. It is a tendril-climber and a very rapid grower and hence it is very desirable for covering a large trellis with its large fine glossy foliage and large bell-shaped flowers. Makes a good pot plant over a balloon. Flowers are dull greenish white in colour on opening but they deepen in a few days to deep rosy purple. Foliage is bronzy green and abundant. When in full bloom, the climber bears blooms of different colours according to their different stages of development. Cobaea cannot be grown successfully in the plains as it is affected by the severe summer. Seeds are flat and they should be sown edgeways. The colour of the flowers is appreciably intensified by the addition of lime and brick rubbish to the soil.

Cockscomb. See under Celosia. Page 434.

Convolvulus. (*Convolvulaceae*). (Morning Glory): Group of handsome climbing plants of great beauty. *C. tricolor* (*C. minor*) is a creeping dwarf annual, $\frac{1}{4}$ to $\frac{1}{2}$ metre high; it is a useful bedding or border, free-flowering annual, with blue or purple flowers with white or yellow centre. Grown in baskets, it is very handsome. Broadcast seeds in the bed and stake the plants when they are having four leaves with green-painted sticks and allow the plants to grow thickly on them. Seeds can be sown all the year round except at the approach of the hot and the rainy seasons. (R.C.)

Convolvulus major = *Ipomoea purpurea* is a popular creeper well suited for covering summer houses, trellis, ornamental, wirework etc. It produces every morning a profusion of flowers, which are available in a large number of shades of colours. Flowers close at mid-day and are hence called Morning Glories.

* **Cosmos.** (*Compositae*). (Mexican Aster): *Cosmea bipinnata* is a delightful, hardy, popular, rainy-season annual, with graceful feathery foliage and large, daisy-like flowers of white, crimson, rose and purple colours. H. $\frac{1}{2}$ to $1\frac{1}{2}$ metres. Flowers are sometimes 7.5-10 cms. across and bear long stalks, making them very useful for cutting and decoration of the dinner table. Some double or crested kinds have been introduced latterly. The plants easily grow into large bushes, branching from the base. B. 2-2 $\frac{1}{2}$ months. Seeds may be sown where the plants are wanted to grow and the seedlings thinned out 25 to 45 cms. apart according to the habit of growth of the variety grown. The plants should be made bushy before they are allowed to flower, by pinching back the shoots. Seeds can also be sown in pots and seedlings transplanted, when they are 5 cms. high. Cosmos can be grown throughout the year. Cosmos 'Sensation' is an early single mammoth flowering strain which produces plants, 1 to $1\frac{1}{2}$ metres high, bearing flowers 10 to 15 cms. across, in about 10 weeks from seed. *C. hybrid Klondyke* grows very tall and robust and produces orange-coloured flowers in about 3 months. H. 1-1 $\frac{1}{2}$ metres. Orange Flare and Yellow Flare are two varieties, free flowering and growing up to 1 metre. (R.S.).

Cuphea. (*Lythraceae*): * *C. miniata*, an annual with scarlet or pink flowers and bright green foliage. H. 30-35 cms. B. 3 months. Grown in pots or in ground. D. 22.5 to 30 cms. Fire Fly is a dwarf compact variety with cerise-red flowers. (C.R.)

C. platycentra=*C. ignea*: A perennial, called the Cigar Plant. Charming and bushy with small dark foliage and scarlet tubular flowers, black and grey at the tip, resembling the ash at the end of a cigar. Propagated from seed or by division.

C. Jorrullensis=*C. micropetala*, much branched, $\frac{1}{4}$ metre high.

* **Cynoglossum.** (*Boraginaceae*). (Chinese Forget-Me-Not): A pretty annual of vigorous growth producing flowers in an erect cluster well over the foliage. H. $\frac{1}{4}$ to $\frac{1}{2}$ metre. D. 30 cms. B. $3\frac{1}{2}$ months. *C. amabile* bears sky-blue flowers. 'Firmament' is a very desirable dwarf variety. Not very satisfactory in the plains. (C.R.).

Datura. (*Solanaceae*): Large, coarse growing annual and perennial shrubs with large, trumpet-shaped flowers, very easily grown. Though ornamental, they are very little appreciated. The fruits, leaves and flowers are poisonous. The following are handsome annuals grown from seed:—

D. cornucopia, called the Horn of Plenty, is a striking species with large double sweet-scented white flowers, marbled on the outside with royal purple. The flowers are often 20×12 cms. *D. chlorantha flore pleno* bears sweet-scented double, yellow flowers. *D. Wrightii* is a showy species with dark bluish green leaves and dark purple stems and white, blue-shaded, sweet-scented flowers. There are many others, grown from seed, either in pots or in the ground.

* **Delphinium.** (*Ranunculaceae*). (Perennial Larkspur): Perennials of great beauty bearing loose spikes of blue or purple flowers. Only the dwarf Chinese type (H. $\frac{1}{4}$ metre) can be grown in the plains if sown early in September. Others thrive, best on Hill Stations and can be tried with partial success in pots at medium elevations. H. $\frac{1}{4}$ to $1\frac{1}{4}$ metre. B. 6-10 months. D. $\frac{1}{4}$ to $\frac{1}{2}$ metre. Germination of seeds is very slow and irregular. Very pretty in borders. (C).

***Dianthus.** (*Caryophyllaceae*): The genus, *Dianthus*, includes some of the most beautiful plants which adorn our gardens. Carnations, Picotees, Pinks and Sweet Williams belong to this genus. They are all herbaceous plants, growing 15 to 45 cms. high, bearing single or double flowers which are available in a good many bright and attractive colours and are valued for cutting. All are perennials by nature, though some of them are raised from seed each time they are wanted; all are useful as pot or ground plants. All the above mentioned kinds dislike excess of water at the roots, being subject to root and stem rot.

***THE CHINESE OR INDIAN PINKS** which include *Dianthus chinensis*, *Dianthus laciniatus*, *Dianthus Heddewigii* as also such types as the *diadematus* and *nobilis* or (Royal) pinks are favourite bedding annuals, both in their single and double flowering forms. *Dianthus* "Sweet Wivelsfield" is a new strain about 30 cms. high of varied colours—a cross between *Dianthus Allwoodii* (hybrid of Carnations and Pinks) with Sweet William. (C).

Sow seeds at the end of the rainy season, in October in the plains and in March on the hills. Do not overwater the pans or the seed-beds or the seedlings will damp off. Transplant seedlings when they are about 2.5 cms. high, and gradually harden them. When they are about 5 cms. high, plant them out in beds, 15 to 22.5 cms. apart. For pot culture, one plant is put in a 15 cms. pot or three in a 22.5 cms. pot. Pinch shoots twice or thrice before flowering for bushy growth. Raised from a mixed packet of seeds, a remarkable variation in the colours of the flowers is noticed, no two flowers being alike. The period of bloom is long and it is further prolonged by regularly removing fading flowers. Well drained light rich soil, sunny situation and careful watering are all that are necessary for success; it is always advisable to keep them on the dry side than overwatering them. B. $3\frac{1}{2}$ -4 months.

***C. DIANTHUS BARBATUS.** (Sweet William), has the same habit of growth as Pinks but the leaves are often broader. Flowers are borne in large trusses, each individual flower being very much like that of a pink. The true Sweet Williams do not bloom in the plains, or even at medium

elevations. But the annual kinds *barbato chinensis*, can be grown in the plains in the cold season, just like Pinks. They require lime in the soil.

**DIANTHUS CARYOPHYLLUS*. (*Darnation*): Carnations are universal favourites. They are grown in pots or in the ground. Flowers are of exquisite form and beauty and are invaluable for cutting. Many kinds are sweet-scented, though some are without appreciable fragrance. The Marguerites have a distinct clove scent. There are distinct types of carnations and all of them can be grown successfully in the cooler parts of the plains and at medium to high elevations, where they thrive best. In the plains only the Marguerites are successful. The following are important types:—

(a) *Border carnations and picotees* are the hardiest of carnations and they are grown in beds and borders in England. The modern varieties of border carnations are the high watermark of quality in carnations. They are distinguished by broad smooth-edged petals, by their dwarf and compact habit of growth, branching usually at the base and not too much on the stem. There is a wide range in the colours of the flowers and according to the colour scheme displayed by them, they are classified as follows:—(1) *Selves* have one decided colour in the petals without any stripes or spots of a different colour. (2) *Bizarres and Flakes* are white-ground carnations. The Bizarre has on every petal, stripes of two or more different colours. In the Flake, the stripes are of one and the same colour, and are evenly distributed. In both the kinds, the stripes should be clear and well defined, and broad on the edge of the petals gradually diminishing until they sink into the heart of the flower. (3) *Picotees* have either yellow or white background; the petals are firm, flat and smooth, and their edges are well rounded and free from fimbriations and bordered with a band of colour at the margin. The line of colour on the edge of the petal may be light, medium or heavy but it should be of one continuous colour and confined to the edge, and (4) *Fancies* are varieties, which cannot be put under any other classes mentioned above; they should be large and have well-shaped brilliantly coloured petals.

* (b) *Tree, Perpetual or American carnations*. Are tall

growing and free flowering and have a tendency to produce lateral shoots on stems, forming a sub-shrubby appearance. Blooms have serrated or fringed petals and are borne throughout the year, and hence the name, Perpetual carnation. Classification into selfs, bizarres, picotees, etc., holds good in this type also. Chaubaud's *Enfant de Nice* and *Giant* are two strains which are recommended strongly for our climate.

* (c) *Malmaison carnations* have a strong and sturdy habit of growth, taking up more room than any other type of carnation. Plants of stiff and massive habit with broad leaves and large fully double flowers mainly pink. Buds rounded and apt to burst; some are as large as *Roses*. They are self coloured and are not borne so very profusely as in other types.

* (d) *Marguerite carnations* are a race of hybrid carnations with fringed, fragrant, clove-scented flowers of all shades of colour. They are very easily raised from seeds and unlike other types, they flower in the same season in which the seeds are sown—in four months. Hence, they are treated as annuals and grown like *Pinks* from seed each time.

Carnations of all kinds are grown in much the same way. B. 4-12 months. Imported seeds produce a fairly large percentage of double flowering plants. Very often, plants of types other than the *Marguerite*, raised from seeds give rise to specimens crowded with stunted shoots producing no blooms. This is particularly so at lower elevations. Sow seeds thinly in well drained pans and keep them in a cool place. Water just enough to keep the soil moist, as seedlings are liable to damp off. When the fourth leaf has formed, prick the seedlings or pot them firmly in 7.5 cms. pots singly, using a compost made up of equal parts of leaf-mould and garden soil and covering the plants to the level of the first seed-leaves. Harden the young plants gradually admitting more and more sunshine to them. Shift them to 25 cms. pots, after they are well established in the smaller pots using Compost No 1 on page 126. Take care the drainage of the pots is perfect, and the roots are not too deep. Keep the soil one level with the collar of the plant. Water sparingly till plants establish after potting. Give them a sunny situation. When the young plants are about 15 cms. high, top them for promoting side growths.

For this hold the plants firmly with one hand and pull off the tops of the shoots or bend the tops of the plants sideways and break them off. Retain only three or four suitable shoots of equal growth. When they grow about 15 cms., top them again and retain only two side shoots on each of them. Treated in this way, fairly bushy specimens are obtained, which if properly cultivated, will give at least 6 to 8 large flowers after disbudding; if no disbudding is done, 15 to 22 flowers can be expected. After the plants establish in the 25 cms. pots, feed them with weak liquid manure prepared from horse-dung, once a fortnight till buds show colour. To dress with a mixture of three parts of powdered rotten horse manure and one part of sand one part of red earth, once in three months, in which case, liquid manuring is unnecessary. Small bamboo thatties, painted green, may be used for staking. These are very obtrusive but they are indispensable for weak stemmed plants. For strong growing kinds, shoots of which stand almost upright, a strong bamboo stick, painted green, and inserted in the middle of the pot will serve as an agreeable support for trying the several shoots as they grow. Disbud, for large blooms. The method of disbudding varies with the varieties but in the majority of cases, the side buds are removed as soon as they can be handled with ease, leaving the top bud in the middle undisturbed. In the case of those kinds which burst the calyx, a small bud adjoining it is kept on till the top bud shows colour to prevent bursting of the calyx. But in some varieties, the calyx bursts inspite of all attempts to check it. Place rubber bands round the calyx one-third away from the base to prevent the calyx from bursting. A fortnight after the plants have ceased flowering, cut them back to 4-6 nodes from the base. After the new growths are about 2.5 cms. in length, top dress or repot the plants. Retain only 6-9 of the strongest shoots of equal strength and size. Treat the plants as before and they bloom again in another four months. After four to five seasons, the plants become too old to be profitably retained.

The commonest method by which carnations are raised is by cuttings. The shoots or growths situated about the middle of the plant make the best cuttings. The method of preparing

and potting cuttings is described below:—Detach a little side-shoot, 5-10 cms. in length, from the plant by pulling it downwards from the stem. Smoothen the heel or cut the cutting under a node if it is a terminal cutting, with a sharp knife. Cut away the leaves at the base to a height of about 5 cms. Reduce the top leaves to half their size if the weather is hot. Put 6 such cuttings in a 15 cms. pot, placing one in the centre and the rest by the edge of the pot. Use pure sand for inserting cuttings. Make holes for their reception with a small dibber in the sand 2.5 cms. deep and insert the slips into them taking care that they rest at the bottom of the holes. Firm the soil round each cutting as it is inserted in it. Water with a 'rose' and place the pot in a propagating frame or under a bell-jar, or in shade, if neither is available. Shade cuttings from strong sun. Keep the soil just moist and do not allow it at any time to dry up. In about four weeks, the cuttings strike root, when they are potted singly in small 10 cms. pots. Treat the young plants as described above for seedlings.

Carnations may also be increased by layers. Layering is done in pots or the shoots may be bent into the soil direct if possible. Usually, a joint half way between the commencement of a shoot and its tip is chosen for making the cut. The shoot is prepared by trimming off all the leaves, except those near the top, with a sharp knife. An incision is made half way through the shoot, with an upward cut, beginning below a joint and passing the blade through it for about 1.25 cms. or so. The layer is bent down into sandy soil and pegged down in such a manner as to keep the slit or tongue open and covered over with sand or light compost. The layers may be separated after two months by which time they may be ready. They are then potted in 10 cms. pots.

* **Didiscus coeruleus**. (Blue-Lace Flower): An upright much branched annual. H. $\frac{1}{4}$ – $\frac{1}{2}$ metre. Flowers are interesting and attractively gathered in lace-like, delicate, flower heads about 5 cms. across. D. 22.5–30 cms. B. 3–3 $\frac{1}{2}$ months. The usual colour is beautiful-sky-blue. There is a white flowered variety also. (C).

Dimorphotheca. (*Compositae*). (African Daisy. Cape Marigold): Quantities of Daisy-like orange flowers, 5 cms.

across, borne on plants about 37.5 cms. tall. *D. aurantiaca* is orange. There are varieties with different colours available. (C).

Eschscholtzia. (*Papaveraceae*). (Californian Poppy): Low growing annuals of easy culture. H. $\frac{1}{4}$ – $\frac{1}{2}$ metre. The foliage is much divided. Large, expanded, saucer-shaped flowers, which measure 10–15 cms. in diameter and are brilliantly coloured and open only in bright sunshine, are profusely borne for quite a long period. Only acclimatised seeds give good results in the plains. Light and sandy soil is necessary. Sow where they are wanted to grow, as the seedlings do not transplant well. Thin seedlings 20–25 cms. apart. B. about 4 months. (C).

Forget-Me-Not. See *Myosotis*.

* **Fuchsia.** (*Onagraceae*): Small herbaceous shrubs with very pretty flowers hanging down the tips of branches as so many ear-drops. Hence the common name for them, Ear-drops. There are several species grown in the garden. The plants are of varying habits of growth. Flowers are double or single. Fuchsias may be obtained from cooler regions and grown only for a season or two in the plains. They do best on Hill Stations and tolerably well at medium elevations. Mature specimens are grown in 30 cms. pots. Some kinds are suited for growing in hanging baskets.

Propagation from seeds is interesting as new varieties are secured this way. Seeds are very tiny and should be sown with the greatest care possible. B. about 12 months. The common method of propagation is by cuttings, which root with no great difficulty. Insert cuttings 5–7.5 cms. long, taken out of the terminal portion of growing shoots in pure silver sand; water carefully and shade them from sun. They strike roots in 3–4 weeks. Pot the rooted cuttings singly in 10 cms. pots in porous soil made up of equal parts of sand and leaf-mould. When the pots are filled with roots, shift the plants to 22.5 cms. pots using Compost No. 2 on page 126. Pinch off the tops of the shoots a number of times for bushy large specimens. Apply weak liquid manure, prepared from horse-dung, once every fortnight. Keep them in a cool place in the summer months and screen them at all stages of their growth

from afternoon sun. The blooming period lasts for nearly a month and a half or more. A month after the plants have finished flowering, prune back the shoots to a third of their length. When the new shoots have made growths of about 2.5 cms., remove a few cms. of the old soil from the pots, and replace them with fresh compost; or put the plants in 30 cms. pots and take particular care in watering. If too many shoots come up, thin them out retaining only the strong ones which give a shape to the plants. Treat them as mentioned above and they flower a second time in another four or five months. This can be repeated a number of times till the plants become old.

***Gaillardia.** (*Compositae*). (Blanket Flower): Hardy attractive bushy bedding plants, some perennials and others annuals, all grown from seed only. Successfully grown throughout the year, valuable especially for summer bedding. Suited for borders and for cultivation in 25 cms. pots. Flowers are very pretty, single or double, and are available in very pretty combinations of orange, crimson, purple, yellow and other colours blended and streaked in various ways. Blooming period, which is very long, is extended by cutting away fading flowers without allowing them to run into seed. Flowers are very useful for making bouquets in which also they last long; they are invaluable for cutting for decoration in vases or bowls. H. 40 to 45 cms. D. 30 cms. B. 4 to 4½ months. *Gaillardia picta* or *Drummondii* is a bedding favourite, bearing large single yellow and coppery red flowers. H. 45 to 60 cms. *Lorenziana double* is a strain bearing large globular double, yellow or red flowers. *G. grandiflora* is a perennial, very popular on account of its large flowers, which resemble small Sun-flowers, mostly in yellow, orange and red colours. (R H C).

Gazania splendens. (*Compositae*). (Treasure Flower): Perennial plant, about 22.5 cms. high, with pointed leaves lined with silver, and bearing beautiful daisy-like flowers, 5 to 7 cms. across, in yellow and orange shades, with striking centre and zone colourings in some varieties. Useful in beds, borders, for edging, and carpet bedding and on rockeries. Propagated by seed or suckers.

Geranium. See under Pelargonium.

* **Gerbera.** (*Compositae*). (Transvaal or Barberton Daisy): Stemless perennial herbs with radical stalked leaves, which are 25 to 30 cms. long and lobed. H. 30 to 37.5 cms. Flower heads are solitary, very pretty, large and star-like, often 10 to 12.5 cms. across, and borne on long and slender stalks. *G. Jamesonii* and its hybrids are well known species for cultivation in the garden. Propagation by division of old clumps or from seed. Seeds do not germinate after three months. They are sown in sandy soil pressing the pointed ends into the soil leaving the fluffy ends sticking out of it. B. about six months. D. 30 cms. Excellent for border and for pot culture. Double flowered varieties are recently introduced in a variety of colours. Useful for cutting. Subject to crown rot and leaf spot. Loamy soil with high humus content and limed sufficiently to give a neutral or slightly alkaline reaction gives best results; needs good drainage.

Geum. (*Rosaceae*): Herbaceous perennial, flowering freely from medium to high elevations. Best treated as an annual and raised from seed every year. Requires a cool shady or semi-shady situation. *G. atrosanguineum* bears deep orange scarlet semi-double rose-like flowers. *G. coccineum* bears bright scarlet flowers. They are hybrids of the latter with rich orange, crimson-scarlet or yellow double flowers.

* **Godetia.** (*Onagraceae*): Annuals, making sturdy little bushes covered with large handsome flowers of brilliant and delicate shades. H. $\frac{1}{4}$ - $\frac{3}{4}$ metre. The colours are pure white, rose, deep red, crimson, and blotched shades. Of late, double flowered kinds are introduced. The plants may be grown in 22.5 cms. pots singly or in beds; D. 22.5 - 30 cms. B. 3½ months. Godetias do not do well in the plains. They are suited for medium to high elevations. They make rank growth in rich soil. Grow them in light soil which is not too rich. Give them just the same treatment as Clarkias. (C).

* **Gomphrena globosa.** (*Amarantaceae*). (Globe Amaranth or the Bachelor's Button): Pretty annual requiring very little attention in cultivation. H. $\frac{1}{4}$ - $\frac{1}{2}$ metre. Bushy plants bearing attractive, globular, everlasting flowers of the diameter of a coat button. The colours of the flowers are white,

pink, rose, and deep magenta. Plant out seedlings, when they are about 5 cms. high; D. 30 - 40 cms. Plants grown in 15 cms. pots are very useful for indoor decoration. (R S C).

* **Gypsophila.** (*Caryophyllaceae*). (Baby's Breath. Chalk Plant): Annuals and perennials. Plants are graceful producing panicles of tiny pure white or pink flowers. The mist-like sprays are very useful for making bouquets and as cut flowers, used along with other flowers of bright colours. Gypsophilas are cold season plants and they do not quite so well thrive in the plains as they do at medium to high elevations. H. 30-45 cms. Sow where they are wanted to grow, as seedlings do not transplant well. Light soil containing lime is best suited. Thin out 20-25 cms. apart. B. $2\frac{1}{2}$ -3 months. Rabbits are fond of this plant and they should be protected by twigs or brambles placed round the beds at night time to scare them away. *G. elegans* is a graceful plant, about 45 cms. high, bearing tall sprays of misty white small flowers. For pot culture, have a single plant in a 15 cms. pot or place three in a 22.5 cms. pot. Blooms are produced 11 weeks after the seeds are sown and last for nearly 20 days. *G. paniculata* is a perennial but in this country, it is treated as an annual. (C)

* **Helianthus.** (*Compositae*). (Sun Flower): The word, Helianthus is derived from Greek, helios, the sun, and anthos a flower, on account of the belief that the flowers follow the sun from east to west. But this is true of only one species, *H. annuus*. Helianthus is a variable genus, comprising of coarse growing hardy plants most of them being annuals. The *Russian Sun flower*, a tall giant sort (H. $1\frac{1}{2}$ -2 metres) producing enormous single flowers, is an economic plant, an oil being extracted from its seeds which are also used as fodder for cattle. H. varies from 1-2 metres; D. $\frac{1}{2}$ - $\frac{3}{4}$ metres according to kind; B. 2- $3\frac{1}{2}$ months. Flowers single or double, in yellow and golden shades. The new *Red Sun flowers*, having the appearance of giant Gaillardias, are handsome in borders. All kinds are useful for planting in clumps or as a background for borders. They may be grown throughout the year. Seeds are sown in well prepared pits where the plants are to grow or sown and transplanted with care. As they are deep rooting, the ground is to be well cultivated and manured. The plants

need staking, as they grow tall, and also copious watering.

The Japanese single kinds, known as the *cucumerifolius*, branch out freely making large bushes bearing numberless small elegantly formed flowers for quite a long period. The colours of these are yellow or golden yellow or yellow with a dark eye. The Excelsior Hybrids bear flowers of bronze, brown and red shades. The *argyrophyllus* with its silvery foilage and medium-sized yellow single flowers with a dark centre is late flowering and quite attractive. Among the double flowered kinds, the *Chrysanthemum-flowered* variety is an improved kind with large yellow flowers, fully double and large, borne over the ends of every shoot of the plant. The other more familiar kinds are the *Globe of Gold*, which bears a number of globular compact flower heads from the side and main stems and *globosus fistulosus* which is a tall growing kind bearing very large perfectly double flowers. (RS).

***Helichrysum.** (*Compositae*). (Everlasting Straw Flower) : Hardy annual bearing everlasting flowers about 10 cms. or more in diameter and of perfect shape and symmetry, resembling half open Roses. Available in several shades of colours as white, pink, salmon, scarlet, yellow, violet, etc. H. $\frac{1}{2}$ – $\frac{3}{4}$ metres. D. 30–37.5 cms. B. $3\frac{1}{2}$ –4 months. Flowers are useful for cutting, retaining their shape and brightness long after they are cut and dried. Not particularly suited for low elevations. Useful, grown in ground or in pot. (C).

***Heliotrope.** (*Boragineae*). (Cherry-Pie) : Hardy herbaceous perennial, popularly grown for its sweet-scented flowers, which are small and collected in panicles, measuring 15 cms. or more across. The available colours are white, blue, and purple and intermediate shades. Valuable as a pot plant and in borders.

H. 45–70 cms. D. 45 cms. B. 4– $4\frac{1}{2}$ months. Though a perennial and can be raised from cuttings or by layering, it is grown like an annual from seeds. When seedlings are 7.5 cms. high, put them in 15 cms. pots. When about 15 cms. high, top them. Transfer to 25 cms. pots finally, using Compost No. 1 on page 126 and stop the laterals again at the third or the fourth leaf. During growth, feed with liquid manure prepared from oil-cake or horse-dung. (C).

Heuchera. (*Saxifragaceae*): Leaves in radical tufts lobed and long stalked. evergreen perennials, growing to about 45 cms. with ornamental foliage and small flowers in long spikes, which make them suitable for house and table decoration. Light loamy soil and a semi-shady situation necessary. Suitable for planting in herbaceous border. Thrives only from medium to high elevations. Raised from suckers or from seed. *H. sanguinea*, coral-red spikes of bloom; *H. rosea*, pretty pink; *H. alba*, white.

Hollyhock. See page 420.

Hunnemannia fumarifolia. (*Papaveraceae*): "Perennial Bush Eschscholtzia" or "Golden Cup Poppy". Perennial, 45-60 cms. high, with rich golden yellow flowers. Best grown as an annual from seed. Does not transplant well and so, best sown *in situ* and thinned out 22.5-30 cms. apart. Germination is irregular and slow and therefore advisable to soak the seeds in tepid water for an hour before sowing. Useful in mixed border. Suited best for medium to high elevations. (C).

Hymenatherum tenuifolium. (*Compositae*): Dwarf annual, H 7.5-10 cms, with delicate fern-like foliage covered with myriads of tiny daisy-like small yellow flowers. Useful for edging or rockery. Easily flowers from seeds in about 2½ months in any ordinary soil and is in bloom for quite a long period. (CS).

Iberis. (*Cruciferae*). (Candytuft): The common name is due to the fact that one of the species was introduced from Candia and the flowers appear in tufts. One of the most popular dwarf free-blooming annuals, very useful for massing in beds and for edging larger flowers in beds and in borders. The flowers are good for cutting too. H. 15-30 cms. D. 15-20 cms. B. 3-3½ months. Thrives with little care; sow seeds where the plants are to remain, and thin out 15-22.5 cms. distances apart when the seedlings can be handled easily. Light rich soil rich in lime suits them best. The *Giant Hyacinth* flowered kind produces strong sturdy plants, about 37.5 cms. high, with few branches and very large pure white blossoms. Candytuft (*I. umbellata*) is available now in crimson, lilac, rose, and purple shades of colour also; but these are

late flowered and do not seem to flower freely at low elevations. (C).

Impatiens. (*Balsaminaceae*). (Balsam): The word Impatiens is derived from Latin, with reference to the pods, which when ripe, on slight pressure burst open, scattering the seeds. Impatiens is a family of highly interesting herbaceous succulent annual and perennial plants, much varied in aspect and valued in gardens for the beauty of their flowers.

* *Impatiens Balsamina* (Balsam) is a very showy annual. H. 37.5-70 cms. Bears large pretty single or double Rose-like flowers of many shades of pure colours and variegated spotted or striped kinds. Balsams are very easy of culture throughout the year. One's garden can be kept gay all the year round by sowing seeds in succession. Balsams need a very rich, friable, open, well drained soil, heavily manured for a previous crop, an open sunny situation, and a very liberal supply of water during growth. Sow the seeds thinly in well drained seed beds and shade them till germination begins. When the plants have formed about six leaves, transplant them into beds, setting them 22.5 cms. apart in regular rows which are 30 cms. apart, or pot singly in 22.5 cms. pots. But, if the plants are grown bushy by allowing the secondary shoots to come up, they should be grown nearly $\frac{1}{2}$ metre apart. Good blooms cannot be had if the plants are overcrowded. In planting, take care to cover the plants up to the first two real leaves. Retain three shoots on each plant but, if very large blooms are desired, pinch off all the side shoots as they come up, growing the plant to a single stem, which becomes covered up with a column of large flowers, produced at the axils of leaves. Remove the lower leaves, which may obscure the blooms. Keep the plants in a moist atmosphere and syringe them in dry weather. As they are gross feeders, supply them with liquid manure once a week. The plants are attacked with mildew at all periods of the year and especially in the cold season. Spraying with Bordeaux mixture effectually checks the onset of the disease. Blooms appear in 60 to 65 days after sowing and the blooming period lasts for about 15 days. Acclimatised seeds do not produce fully double flowers. (RCS).

* *Impatiens Sultani* and *Impatiens Holstii* are well known as Wild or Hill or Zanzibar Balsams. They are erect, branching, perennial succulent herbs, $\frac{1}{4}$ – $\frac{1}{2}$ metre high, with pale green leaves and beautiful flowers with spreading petals, borne in plenty. Hill Balsams have a compact habit of growth and are perpetual bloomers. Flowers are produced so freely that a well grown specimen appears a mass of flower. On rockeries, they make a splendid show. They thrive excellently well in semi-shady situations. They form also very attractive and valuable pot plants. Originally, only the scarlet colour was available but now, several hybrids in pure white, rose, orange, brick-red, crimson, pink and other shades are introduced. The plants are very easily raised from seed or by cuttings. They need plenty of moisture during period of vigorous growth. Plant them 45 – 60 cms. apart in beds in shade-gardens or singly pot them in 25 cms. pots. Pinch back the straggly shoots to brush them out.

There are several other species of *Impatiens* which are worth growing:—

I. Hawkeri is a herbaceous perennial; free blooming; bears large carmine flowers with a white eye. Succeeds well in the plains.

I. Oliverii is a herbaceous perennial; forms a large bush. Flowers are nearly 5 cms. in diameter and pale rose in colour. The plant needs a moist conservatory and thrives in places, 500–1000 metres above the sea. Raised from seed or by cuttings.

I. Hookeriana is a very succulent much branched herbaceous perennial, with long stalked leaves; H. $\frac{1}{2}$ – $\frac{3}{4}$ metre; flowers are large, white and spotted with purple on the larger lower petals. Successfully grown 500 metres above sea level.

* *I. aurea* = *I. repens* = *I. malabarica* is a herbaceous compact low-growing plant with red stem and bright yellow flowers. Excellently suited for rockeries, hanging baskets, and low bedding. The plants are liable to damp off in summer and hence a number of plants should be made to safeguard against total loss.

Ipomoea. (*Convolvulaceae*): “Morning Glory”. Easily grown annual climbers, useful for brightening trellis quickly.

B. 2-2½ months. (RSC). Following varieties are noteworthy:— White Magic—large fleecy white flowers; Scarlett O' Hara—very attractive dark wine coloured flowers; Pearly Gates—pure white large flowers; Cornell, large red flowers, bordered white; Heavenly Blue—sky-blue flowers with yellow throat; Daphniensis—large attractive flowers of biscuit colour with crimson centre.

I. quamoclit. (Telugu: Kasiratnam): is a pretty creeper, native of India, with small ruby like crimson flowers. Foliage filamentous and elegant.

***Kochia.** (*Chenopodiaceae*). (Burning Bush. Summer or Mock Cypress. Fire Plant): Hardy annual, with very narrow pea-green ornamental leaves, forming globular bushes similar to clipped Cypress. The plant is useful for annual ornamental hedging, and it makes a delightful foliage plant for pot culture. It can be clipped to any desired form. As the plants get old, the leaves turn crimson in colour. The flowers which are crimson in colour and inconspicuous, together with the leaves, make the whole plant look a ball of fire. Easily grown from seed. H. ½-¾ metre. Reaches maximum size in 3-4 months after sowing. (R).

***Lady Lace.** See under Pimpinella.

***Larkspur.** (*Ranunculaceae*): Very showy annual, freely producing spikes of beautiful flowers, available in blue, lilac, purple, white, and pink shades. H. 22.5-75 cms. The seeds germinate best only in cool weather in moist place. Germination is however irregular and slow. Flowers are useful for cutting. Effective in beds and in borders. The Stock-flowered kind is the best for low elevations, where the Double Flowered kinds do not satisfactorily thrive. The Giant Imperial strain is recommended for medium to high elevations. Acclimatised seeds give best results. Sow where they are wanted to grow and thin out 20-30 cms. apart. For pot culture, put 3-4 plants into a 25 cms. pot using great care not to injure the roots while transplanting. B. 2½-3 months. (C).

***Lathyrus odoratus.** (*Leguminosae*). (Sweet Pea): A very popular annual, very much like the common edible Pea in habit of growth, bearing sweetly fragrant, blooms of wonderful variety in colour. On account of its range of

colour, beauty of form, fragrance, and its value as cut flower, Sweet Pea stands very high in rank among annuals. Within the last 75 years, great improvements have been effected in colour, size and form of the flowers. A good selection of seeds may be made from a catalogue of any recognised firm.

Sweet Peas are grown very much like their vegetable ally. They love an open sunny situation, which has plenty of light and air. In shade, the plants grow spindly and weak, bearing only a few flowers. The soil should be light and rich and worked to a depth of $\frac{1}{2}$ metre as Sweet Peas are deep rooting. Plenty of well decomposed manure should be mixed with the soil. For success, dig out trenches, $\frac{1}{2}$ metre in depth, 40 cms. wide, in rows 1 metre apart and sow the seeds 5 cms. apart in the rows of soil so prepared and cover them up 2.5 cms. deep. On the plains, near the coast, Sweet Peas are difficult to grow. In the interior of the country and at medium elevations, they do well. The Australian and Early Flowering strains give best results. Acclimatised seeds do better than imported ones. Keep the soil well cultivated and make shallow furrows about 12.5 cms. from the rows on either side, so that the plants may be watered liberally in seasons of drought. Thin out seedlings 10 cms. apart. Pinch the tips, when the shoots are 15 cms. high. As soon as the plants are 30 cms. high, support them with twigs having a few side branches, placed against them. This also prevents the plants from being injured by wind. When buds appear, liquid manure made up of 28 gms. of sulphate of potash, 57 gms. of sulphate of ammonia and 57 gms. of superphosphate in 36 litres of water applied once a week gives excellent results and with the removal of withered flower and pods, prolongs the blooming period considerably. For culture in pots, seven seeds may be sown in a 30 cms. pot and the plants grown as suggested above. Of the insects and diseases that attack Sweet Peas, the following are common:— (1) Aphis. (2) Root-rot. (3) Mildew. *Vide* Chapter XI for remedies. (C).

***Leptosyne.** (*Compositae*): Light foliaged; yellow or golden yellow daisy-like flowers, useful for bedding and cut

flowers; requires rich calcareous loamy soil; killed by too much of water; H. 30-60 cms. D. 30 cms. B. 2-3 months; *L. maritima* is the best known variety.

***Linaria.** (*Scrophulariaceae*). (Toad Flax): Charming hardy free flowering annuals, growing about a $\frac{1}{2}$ metre in height, and very beautiful when massed in beds and borders; miniature *Antirrhinum*-like flowers are produced in great profusion in erect spikes. They are very useful for cutting, for bouquets and vases. *Linarias* do not seem to flower freely in the plains but they do very well at medium elevations. Seeds are very small in size and hence should be bulked with fine soil before sowing to secure even and thin sowing. Sow them where the plants are wanted to grow and carefully water with a fine roset can till the plants are about 5 cms. high. Thin out the seedlings, 15-20 cms. apart, and pinch the tops of the shoots once or twice for bushy growth. Over-watering kills the plants. B. 3-3 $\frac{1}{2}$ months. The plants remain in bloom for a very long period. (C).

Linum. (*Linaceae*). (Flax): The genus comprises of annual and perennial plants. *L. grandiflorum*, the Scarlet Flax, is one of the most effective and showy annual bedding plants of a long blooming period. It is erect growing, reaching a height of about 45 cms. with a delicate stem and fine foliage and bearing in great profusion showy five-petalled flowers, which are 2.5 cms. in diameter. As the plants do not stand transplanting, sow the seeds where the seeds plants are wanted to grow, and thin out to 15 cms. *L. perenne* or the perennial kind grows to a height of $\frac{1}{2}$ metre and is suited for mixed borders. It may be propagated by division. It is very ornamental in the cold season at the margins of the shrubbery. Perennial kinds are only suited for medium elevations but the annual kinds can be tried in the plains. (C).

***Lobelia.** (*Campanulaceae*): A large family of annuals and perennials. Exceedingly pretty, profuse flowering plants of great value in the garden. H. 8-45 cms. Some kinds are particularly suited for growing in hanging baskets, in window boxes and in vases and for pot culture. Dwarf kinds are useful for edging larger plants in beds or borders. *L. erinus* is a very variable species, in point of the colour of the foliage,

the size and colour of the blooms. *L. erinus compacta* is compact and dwarf and is suited best for edging purposes. *L. erinus variety hybrida pendula 'Sapphire'* is of slender growth and is hence suited best for vases and baskets. Of the tall kinds, *L. erinus ramosa* and its hybrids are best suited for pot culture and herbaceous border. They attain a height of 25-35 cms. and are available in white, light purple and blue and pink shades. Sow the seeds thinly in seed-pans. When the seedlings are about 2.5 cms. high, prick small clumps of them containing two or three plants 10 cms. apart into a fairly light soil contained in 22.5 cms. pots. Protect them from afternoon sun. As the plants grow, insert four to five bamboo round sticks about a 30 cms. long and painted green by the edge of the pot at equal distances apart and pass round them thin raffia or plantain fibre to keep the plants from straggling about. In $3\frac{1}{2}$ - 4 months, the plants bloom and retain their beauty for quite a long period. Except one or two varieties, Lobelias do not thrive in the plains. *L. cardinalis* is a pretty pot or bedding perennial plant, $\frac{1}{2}$ metre with bronze coloured foliage and bearing scarlet flowers in terminal racemose spikes. It takes a year to flower from seed. But, from young suckers, it comes up to bloom in about five months. *L. fulgens* resembles *L. cardinalis* but is larger and downy. But the above two species may be successfully grown at medium to high elevations. (C).

Lupinus. (*Leguminosae*). (Lupin): An extensive family of hardy annual and perennial plants easily grown on any good garden soil. H. 20 cms. to $\frac{3}{4}$ metre. Ornamental in bloom with tall spikes of pea-like flowers of white, yellow, blue and other colours. Useful for bedding, in borders, and for pot culture. Annual kinds may be successfully grown at medium elevations. Seeds should be sown where the plants are to flower permanently, as seedlings do not transplant well. They are hard-coated and should be immersed in water for half a day before sowing. Acclimatised seeds give best results. The soil should contain lime and not be too moist. In order to save seeds, when the pods on the lower part of the flower-stalks have grown nearly to their full size, the tops of the stalks should be pinched off and the plants shaded from sun.

If this is not done, the pods shrivel up without maturing. Thin out seedlings 30-45 cms. apart. B. 3 months. (C).

Marigold. Seed under Tagetes.

Mathiola. (*Cruciferae*). (Stocks): Genus of several species, consisting of annuals, biennials and perennials all differing very little except in size and form of their blooms and the time taken to bloom from seeds. The biennial and perennial *Mathiolas*, which include the pretty *Brompton Stocks*, do not thrive in this country except on hill stations. *Ten-Week Stocks*, which are annuals, thrive at medium to high elevations only. They grow $\frac{1}{4}$ – $\frac{1}{2}$ metre. with lance-shaped leaves and produce erect branching spikes, of deliciously fragrant flowers; these annual stocks are useful for bedding and for pot culture. Seeds obtained from recognised firms yield about 70% of double flowering plants. Acclimatised seeds yield better results at medium elevations than imported seeds. Seedlings are liable to damp off unless great care is exercised in watering. Sparingly water the seedlings; transplant then when they are about 5 cms. high, in well prepared beds, containing very rich soil, 20–30 cms. apart, or pot singly in 20 cms. pots. B. 4–4½ months for annuals and 7–8 months for biennials. (C).

* **Michaelmas Daisy.** (*Compositae*): *Aster amellus*, called the Michaelmas Daisies, are known also as Perennial Asters. They are herbaceous perennials quite distinct from the China Asters, which are annuals. Michaelmas Daisies are low growing plants, throwing a number of suckers from the base, making clumps. Flowers are single and are composed of a central disc and numerous rays. They are produced in plenty on sturdy flower-stalks in erect conical bunches. There are several varieties of perennial asters, producing stalks of flowers, 20 cms. to 1 metre, in white rose, magenta, blue, lilac and purple colours. Michaelmas Daisies, thrive best from medium to high elevations only, where they grow tall and freely flower. Some white flowered varieties may be successfully grown at lower elevations. All the varieties are hardy and attractive and serve as handsome border, or bedding or pot plants.

Easily propagated by division of the clumps and rarely

from seed. Each little plant with its crop of roots is separated from the parent plant or clump with a sharp knife or by pulling the several pieces apart, and started independently. As soon as the new plants are sufficiently established, they are planted in 25 cms. pots or in beds 20 - 30 cms. apart. Flowers are produced in 3 - 4 months after planting. Suckers, which continually come up from below, should be removed frequently. Liquid manure given once in 15 days during growth is attended with good results. Unless at planting time, suckers of about the same size are planted, plants do not bloom all at once in beds. After blooms are past, flower stalks are cut away; the soil is raked up; manure is forked in; and only once or two suckers are retained on each plant, removing all the others. Plants, thus treated, produce a fresh crop of flowers and this process can be repeated a number of times. But it is advisable to dig up beds after they have flowered twice and replant them with new plants. Michaelmas daisies are at their best during the cold and the rainy seasons. (C R).

Mignonette. See under Reseda.

Mimulus. (*Scrophulariaceae*) (Monkey Flower): Genus of handsome profuse flowering perennial plants, which are treated as annuals and grown from seed each time. Flowers are brilliantly coloured and are distinguished by their rich striking markings. They are Gloxinia-like, interesting and gape-mouthed; probably the common name Monkey Flower is given on account of this fact. *M. tigrinus* grows 20 cms. high and has fine spotted and blotched flowers with yellow as the ground colour. *M. cardinalis* has showy scarlet flowers. *M. moschatus* has a delicious musky smelling foliage and bears yellow flowers.

Seeds are tiny and hence bulk them with sand for even sowing. Sow in seed-pans and water from below. Prick out seedling as soon as they can be handled with ease, singly into small 7.5 cms. pots. After these pots are full of roots, shift plants to 20 cms. pots, using a rich compost which contains plenty of sand. As they are semi-aquatic plants, they require a plentiful supply of water when they are making vigorous growth. Best suited for medium to high elevations. B. 3 - 3½ months. (C).

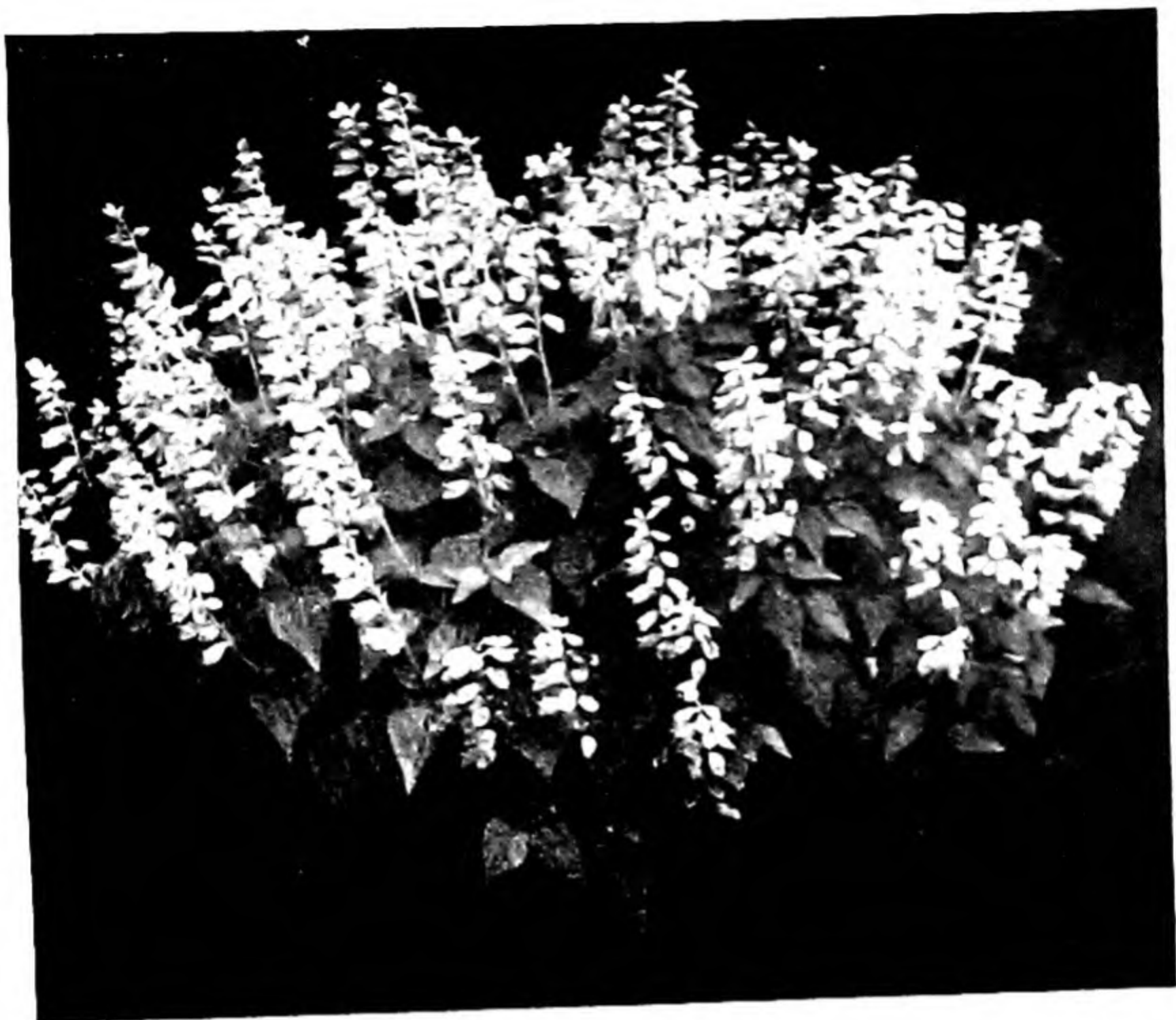
* **Mina lobata** = *Impomoea versicolor*. (*Convolvulaceae*): An attractive popular, elegant, slender, annual climber, having a foliage of deeply divided leaves, and bearing long graceful racemes of red and creamy orange flowers, peculiarly arranged on one side of the main stalk. A rapid and easy grower, reaching 4 metres. Three plants grown in a 35 cms. pot furnished with a balloon of split bamboo are strikingly beautiful. This is also called "Belgian Flag creeper". New seeds germinate without trouble. Old seeds may be soaked in warm water. B. 4 months. (C R).

Myosotis. (*Baraginaceae*). (Forget-Me-Not): Charming dwarf popular perennial herb, 10-15 cms. high, bearing beautiful little flowers, which though small are full of life and appealing in their looks. The flowers are light blue with a golden eye or rose or white or purple, there being numerous kinds and varieties. Forget-Me-Nots are beautiful in shady nooks and beds, where many other plants would not flower well, and are exquisite for cutting and for wearing in button holes like Pansies. Being semi-aquatic they thrive in damp and semi-shady situations and like being watered liberally. Do not thrive at low elevations, where they cannot survive the heat of the summer. Though perennials by nature and can be propagated by cuttings, they are mainly grown as annuals from seed, from which they take 5-6 months to flower. They are usually grown in shallow broad pots (seed-pans). The blooming period lasts for about two months. (C R).

* **Nasturtium**. See under *Tropaeolum*.

Nemesia. (*Scrophulariaceae*): Annuals, charming grown in clumps in beds or borders or as edging plants. Do not thrive in the plains. Sow where plants are to flower. Pinch out tops for bushy growth. Light rich calcareous loamy soil best suited. H. 15-20 cms. D. 20-25 cms. B. 3½ months. *N. strumosa Suttoni* bears fascinating flowers, available in several colours. Acclimatised seeds give better results than imported ones at medium elevations. (C).

Nicotiana. (*Solanaceae*): (Flowering Tobacco): The common Tobacco, *N. tabacum*, which is of economic importance and is grown commercially for its leaves, bears



SALVIA SPLENDENS



VERBENA HYBRIDA



RUDBECKIA BICOLOR SUPERBA



PHLOX DRUMMONDII. MIXED

rose coloured flowers. For the garden there are more attractive species, which are furnished with handsome foliage of large broad leaves and which produce beautiful large tubular flowers on long stalks, about $\frac{1}{2}$ metre tall. They are grown in pots or in the ground with ordinary care. Sow the small seeds thinly. Prick the seedlings when they have formed four leaves. When large enough, plant out or into 15 cms. pots. Later on, shift to 25 cms. pots. Water freely during period of vigorous growth. D. 30 cms.; B. $3\frac{1}{2}$ -4 months. Stake flower stalks. (CS).

The following are noteworthy species:—

N. affinis = *N. alba grandiflora*, called the Sweet Scented Tobacco. Grows about $\frac{3}{4}$ metre high and bears hundreds of sweet-scented white flowers. Its hybrids bear flowers of crimson and red shades. H. $\frac{1}{4}$ - $\frac{3}{4}$ metre.

N. Sanderae, called Flowering Tobacco, are hybrids of *N. affinis*, and *N. Forgeti*, a red flowered species; they show a fine range of shades in crimson and pink; flowers are very large, measuring in some varieties 12 cms. in length, but are without fragrance.

Nigella damascena. (*Ranunculaceae*). (Devil-in-a-Bush; Love in-a Mist): Annual with pretty cut foliage and attractive curious flowers hidden in the light feathery foliage. Seedlings do not transplant well. Sow thinly and thin out 20-35 cms. apart when 7.5 cms. high. If plants are spindly, pinch out centres to bush out the plants. Thrives in any good soil with a large lime content in a shady and moist situation. Flowers, white or blue. H. 30-45 cms. (C).

Nierembergia hippomonica (Cup flower): A very pretty perennial. Grows to 20 cms. to 30 cms. high, bearing number of blue and white cup flowers of the size of about 2 cms. across.

Oenothera. (*Onagraceae*). (Evening Primrose): Group of generally trailing, naturally perennial plants, growing wild on the hill stations and suited for places 600 metres above the sea. They are well known as Evening Primroses and are useful for borders, edgings, beds or rockeries. Flowers are showy, large and saucer-shaped, white or yellow or rose or pink coloured. They open in the evening. Seeds should be sown where the plants are desired to bloom, as they do not transplant

well. *O. Drummondii*; *O. rosea*; and *O. speciosa*; and *O. odorata* are fine species. (C).

Orthosiphon stamineus. (*Labiatae*): A little herbaceous perennial plant, $\frac{1}{2}$ metre high, bearing very interesting pale lavender-coloured flowers with long white projecting stamens. Hence, sometimes called Cats Whiskers. It requires a situation, which is shaded from afternoon sun and it is suited for beds in shade gardens. Raised and grown easily from seed or by cuttings.

***Pansy.** (*Violaceae*): Small perennial herbs, 15-20 cms. high, but treated as annuals being raised from seeds every time they are grown. Believed to be derived from *Viola tricolor*; there are few plants more popular than the Pansy. Its folk name, "Hearts-Ease" is very suggestive of its appealing power to one and all. Very pretty, brilliantly coloured flowers of butterfly-like appearance are borne freely. Pansies are available in all shades of colours and in almost all combinations of colours by way of blotches, stripes and dots. There are several strains varying in size, substance, colour and shape of the flowers. *The Trimardeau*, *Bugnot's*, *Masterpiece* and *Orchid flowered* strains are noteworthy. The *Masterpiece* type is noted for large flowers with curled or ruffled petals. The *Orchid-flowered* type is noted for the delicate orchid-shades of colours. Some of the modern introductions of Pansies measure nearly 10 cms. across. *Roggli Giants*, *Engelmann's Giants*, and *Swiss Giants*—all bear large flowers. The *Tufted Pansies* are dwarf and not of a spreading habit as the florist's types. *Tufted Pansies* bear smaller sweet-scented blooms but in greater numbers in clusters and are more suitable for bedding. Pansies, are charming pot plants. Flowers are invaluable for cutting, for button-holes and bouquets.

Pansies degenerate quickly and hence obtain seeds of the best strains from reliable firms. Sow seeds in seed-pans thinly in light porous soil. Germination is very capricious and irregular. Wait till all seeds have germinated and the seedlings are fit to be handled with ease. Then, pot them singly in 10 cms. pots in a compost of equal parts of loam, sand, leaf-mould, and horse manure. Do not disturb the soil while taking out the seedlings from the nursery bed or the seed-pan, as

germination of some seeds takes place long after others have germinated. When the plants have well established themselves and filled the small pots with roots, shift them to 22.5 cms. pots. Pinch tops of the plants twice or thrice for compact specimens. Stir the soil frequently, once in 15 days, to a depth of 2.5 cms. or the plants do not flower freely, becoming too full of roots and pot-bound. Water freely in the evening. Do not expose the plants to noon-day sun. Remove flower buds till plants have grown sufficiently large to cover the pots. Feed with liquid manure prepared from horse-dung once a fortnight. For large blooms, retain only one flower per shoot. Cut the flowers as they fade, without allowing them to run to seed. The blooming period may be kept up for nearly two months. B. 4 months.

Particularly attractive and noteworthy varieties, which cannot be propagated from seeds with certainty, can be increased by cuttings. (C).

Papaver. See under Poppy.

***Pelargonium.** (*Geraniaceae*) : Commonly known as Geranium. The genus *Pelargonium* includes the garden varieties of Geranium. Pelargoniums are Cape plants and the modern varieties are crosses between certain species. Geraniums, in general, are popular herbaceous perennial pot plants grown for the beauty of their flowers which are borne in large trusses. Some kinds are grown for their foliage. H. 20-60 metres. Propagated easily from cuttings or from seed. Geraniums do not thrive well in the hot plains of India, especially at places where the rainfall is heavy. They need protection from hot winds, severe sun and rain in the rainy season. In all seasons, they should be watered very carefully, a certain amount of root dryness being absolutely necessary for their successful culture. They do not relish overhead waterings. Over potting and too generous supply of rich soil conduces to rank growth and few flowers. New plants produce larger and healthier blossoms than old ones. Grand specimens may be built up by placing 3 plants in a 25 cms. pot. Early growth and underpotting are two essentials which need to be emphasized in the cultivation of Geraniums.

There are several distinct kinds of Geraniums and most of the cultivated forms may be grouped into five horticultural classes. They are :—(1) The *hybrids derived from P. inquinans*. These are available now in different shades of colour from white to intense scarlet. The leaves are almost circular, soft to the touch and are margined by large blunt teeth. These form the hardiest class of Geraniums, and are better suited for culture in the plains than other. (2) *Zonal Geraniums* derived from *P. zonale* are distinguished by horse-shoe markings on the leaf, which may be all brown or golden or bronze and golden or silvery white. *Bicolor* has leaves green edged with white or white edged with green. *Tricolor* has leaves green edged with white yellow, and crimson. *Bronze* has yellow leaves with bronze zone. The flowers may be single or double. The plants are less hardy than the preceding class and do not seem to thrive in places below an elevation of about 750 metres. (3) *Ivy-leaved Geraniums* are derived from *Pelargonium peltatum* and they have trailing slender stems and polished, thick, dark green leaves. They are effective in window boxes, in hanging baskets and vases. Flowers are single or double. Recently some compact growing hybrids between Geraniums and Ivy-leaved Geraniums are introduced, which partake of the characters of both the types in foliage and flower. (4) *The Show, Decorative, and Fancy Geraniums*, derived from *P. grandiflorum* and *P. cucullatum* bear large flowers. They are much more difficult to grow than the Zonals and cannot be grown even at medium elevations. (5) Various scented leaved Geraniums, known as *Rose-Geraniums*, These are derived from *P. quercifolium*. These seldom flower but they are grown for the delicious fragrance of their leaves which go into Indian flower garlands. The Geranium Rose scent is manufactured from them.

Geraniums are cultivated in the following manner:—Allow the parent plant from which the cuttings are to be taken to suffer for want of water for a day or two. To secure best results, propagate only from perfectly healthy stock. Select shoots, which are neither too firm or woody nor too tender or flabby in texture. Cut them sharply under the nodes, keeping the length of the cuttings from 10-20 cms. Strip the leaves

from them, without injuring the skin, leaving two or three at the top. See illustration 32. Insert six such prepared cuttings in soil consisting of equal parts of sand and well sifted leaf mould contained in a well drained 15 cms. pot by its edge. If too many are inserted in a pot, the roots of the cuttings get mixed up and break while separating them and take a long time to establish. Keep the pot in semi-shade or even in the open, if the sun is not severe. Keep the cuttings on the dry side till callus is formed. Never overwater them or expose them to rains. In 4 to 5 weeks, the cuttings strike roots and show growth at the top. Pot them singly in 7.5 cms. pots in soil, composed of equal parts of loam, sand, and horse manure. Shift them finally to 22.5 cms. pots using a compost made up of 2 parts red earth, 1 part of sand, and 1 part of manure. Firm the soil well to have stocky plants bearing more blooms and less leaf. If growth is too vigorous and the shoots are too long for the plant to be tidy, nip off the tops for side shoots to be produced. Examine the soil at least once a fortnight for cockchafer larvae, which devour the roots and kill the plant in a short time. Thin the foliage, when it gets crowded too much, to turn the energy of the plant towards flower production. Till the plants have made sufficient healthy growth, keep removing flower buds. Disbud till 35-40 days before flowers are wanted. While in bloom, limit the supply of water. After the flush of blooms is over, allow the plants to rest for about a month and then prune back the shoots. As new growths are 3 cms. or so in length, report or top dress the plants. Treated this way, the plant becomes bigger in size and produces larger number of blooms in about $3\frac{1}{2}$ months after repotting. Reject old plants after two or three seasons. Pruning and spraying are the two of the biggest jobs in a Geranium grower's routine.

Geraniums are easily raised from seed. Sow them in well drained seed-pans, placing the seeds about 1.5 cms. apart and cover them up with about $\frac{1}{2}$ cms. thickness of fine soil. Water carefully, never keeping the pan wet. If overwatered, seedlings easily damp off. When leaves of the seedlings touch each other, pot them singly in 10 cms. pots, in light porous soil made up of a part each of sand and red earth and $\frac{1}{2}$ part

manure. Pot firmly. Water sparingly to start with and increase the supply as growth progresses, never keeping the soil wet for a long time. Shift plants to 20 cms. pots using compost recommended above. Treat the plants now on as suggested above in connection with those raised from cuttings. Seedling plants have a thick tap root and few fibrous roots and hence are more liable to rot from overwatering than plants raised from cuttings.

The chief enemy of Geraniums is the larva of the cockchafer. The soil has to be periodically examined and the grubs handpicked, and the manure used should be free from them. Certain caterpillars eat the flowers. They are also handpicked.

***Pentstemon.** (*Scrophulariaceae*) : Herbaceous perennial of great garden value and ornament. It is a very satisfactory bedding plant and has a telling effect with its large erect spikes of tubular, open-mouthed, Gloxinia-like flowers, which are available in several shades of colours. The new hybrids, with the throats of the flowers very prettily pencilled and variegated with different colours are very attractive. In Bangalore, Pentstemon is usually grown in pots. It may be raised by division of old plants or by cuttings or by seeds. From seed, flowers are produced in 8 to 9 months. From cuttings or by division, plants can be got to bloom in 4-6 months. Sow seeds in friable soil in seed-pans and cover thinly and water the soil from below as the seeds are very minute. When seedlings are fit for handling, pot them off singly in 7.5 cms. pots and later shift them to 25 cms. pots. Use Compost No. 1 on page 126. For bushy growth, pinch back the young plants twice or thrice before flowering. During growth, supply them with water regularly. They would die if they receive any severe check in growth. Remove flower spikes after they are past their best to benefit the secondary shoots that come up soon after and bear blooms in their turn. Cut back the flowered shoots, after the plant has finished flowering, to 4 or 6 nodes from the soil level; out of the new growths which are produced, retain 6 to 8 and remove the rest and treat the plants as before till another crop of flowers is obtained. Apply a top dressing with rich mixture of 2 parts of horse-manure and 1 part of loam once in three months to

sustain the plants in vigorous condition. Repot once in every six months.

* **Petunia.** (*Solanaceae*): Petunias are one of the loveliest ornaments of the garden. They are soft sun-loving plants of a rather straggling or decumbent habit of growth, bearing large showy flowers. The flowers are single or double, are often 10 cms. across, are available in all shades of colour except the pure yellow. The best strains of hybrid Petunias are noted for their large sized blooms, beautifully blotched or striped or variegated in different colours. Many of them are beautifully ruffled and frilled in various ways. The single dwarf *nana compacta* kinds are usually grown in beds, and the improved large flowering kinds and doubles in pots. For hanging baskets the Balcony or hybrida pendula type is particularly suited. Petunias grow to a height of 20-45 cms. and produce a mass of bloom. The double flowering kinds are often treated as perennials and are raised from seeds as well as by cuttings. Seeds are very tiny and hence should be sown with care. Late winter to end of summer is the best time to have Petunias in bloom, as they are liable to rot and die in the rains. Prick the seedlings when they can be handled with ease, in light porous soil in well drained seed-pans, five cms. apart. Do not reject very small seedlings, as they are likely to be those which produce the finest shades of colour. When the pricked plants are strong enough, plant them singly in 20 cms. pots, using Compost No. 1 on page 126. Overwatering of the plants at any stage of their growth is sure to kill them. As soon as they begin to branch freely, pinch the tops twice or thrice to produce large number of shoots and hence flowers. Treated this way, they may not require any stakes to support them, as they make short and sturdy growth. If any staking is necessary, insert three to four slender sticks painted green by the edge of the pot at equal distances apart and pass round them thin raffia for the plants to rest on. While watering, do not splash the water on the leaves. The double flowers do not seed freely in this country and so the seeds have to be imported from foreign firms. The single flowering kinds also degenerate after two sowings and so to maintain the standard,

seeds have to be got from reliable firms. For ground culture, D. 30-45 cms. B. 4-4½ months. (C S).

***Phlox.** (*Polemoniaceae*): *Phlox Drummondii* is a favorite of one and all, being a very pretty free blooming annual, which is very easy to grow. It is effective in beds or in pots. There are three strains of this beautiful annual, viz., the grandiflora, attaining 30 cms. in height and bearing large flowers; the intermediate type, growing about 20 cms. high; and the compact or 'nana' type, growing only 10-15 cms. high. Flowers are profusely borne in large trusses, often measuring 10-12 cms. across, covering from ground to summit of the plant. They are available in all imaginable single colours or in handsome combinations of these in striped, blotched or eyed kinds. The petals are usually round but they are twisted and angular in the 'stellata' type. Phloxes require a rich open soil, sunny situation, and just enough watering to keep the soil moist. They are best suited for summer bedding. Sow in seed-pans or nursery-beds; prick when the seedlings are ready; and transplant 15-20 cms. apart in beds. For pot culture, pot 5-7 plants into a 25 cms. pot. Pinch back shoots twice or thrice before flowering for large bushy plants. B. 3½ months. Bloom earlier if directly sown where wanted to flower. Period of bloom lasts for over a month. (C.S.).

*** Phlox decussata.** (*Polemoniaceae*). (Perennial Phlox): One of the choicest herbaceous perennials, ¼-½ metre high, mainly propagated by suckers and rarely from seed for new varieties. Flowers are similar to the annual Phloxes but are less varied in colours and the trusses are larger and conical in shape. Perennial Phlox is usually grown in pots, each plant being confined to one to three shoots only. It is grown very much like Michaelmas Daisy. A sucker taken out of a healthy plant and grown in a 20 cms. pot blooms in 3½ to 4 months. Rich soil and protection from afternoon summer sun necessary. Mealy and green bugs and scales are the greatest enemies of this lovely plant. Infected leaves and stem should be washed with fish oil soap. Not suited for plains.

Pimpinella monoica. (*Umbelliferae*): Known as Lady's Lace. Annual; Coriander-like smell of leaves; H. ½-1 metre small lacy white flowers in large loose sprays, useful for vases

and bouquets. B. 3 months. (C). Suited best for medium to high elevations.

Pinks. See under *Dianthus*.

Platycodon. (*Campanulaceae*). *P. grandiflora* = *Campanula grandiflora* called the Japanese Bell Flower or Balloon Flower. Hardy herbaceous perennial, 35-60 cms. high, with blue or white campanulate flowers, nearly 7.5 cms. across. Forms thick roots which live a number of years producing annual shoots, which die down after flowering. Raised from seeds. Germination is slow.

***Poppy.** (*Papaveraceae*). (*Papaver*): Poppies form an interesting class of popular garden plants. Flowers are single or double and are of varied and bright colours and appear well above the elegantly cut foliage on their long and wiry stalks. It is a great pity that the blooms are short-lived but the profusion and the freedom in flowering make up for this demerit. The best garden Poppies are the well known Shirley Poppies, which are annuals, with single or double flowers. The flowers are often $7\frac{1}{2}$ -10 cms. across and are available in a surprisingly varied range of colours, from white to almost black. All the poppies are easy to grow. But they do not thrive well on the plains of India. They can be grown with little care under sub-tropical conditions. H. $\frac{1}{2}$ - $\frac{3}{4}$ metre; D. 30 cms.; B. $2\frac{1}{2}$ - $3\frac{1}{2}$ months. (C).

There are four species of Poppies, which are commonly cultivated and they are all distinct. They are (1) *P. Rhoeas*, the Corn Poppy of Europe with a neat dwarf habit of growth and finely cut hairy foliage and small flowers. * *The Shirley Poppy* is the best strain of this class. (2) *P. somniferum*, the Opium Poppy. It is an annual of tall and stately habit of growth and its flowers are very large though they are useless as the petals drop off as soon as the flowers are cut. Opium is made from the juice of this plant, which it produces on being lightly cut when young. The *Carnation* and *Paeony-flowered* kinds belong to this class. (3) *P. nudicaule*, the *Iceland Poppy*. These are excellent for cutting. They are short-lived perennials, grown from seeds as annuals. They are mostly yellow flowered, though recently other colours are introduced. (4) *P. orientale*, the *Oriental Poppy*, is also a perennial but for

garden purposes, it is treated as an annual. It grows to 1 metre and is stiff and hairy and is suited for growing in the shrubbery.

Cultivation of Poppies is simple. Seeds germinate readily. Sow them soon after the rains in light rich soil where the plants are wanted to grow as the seedlings do not transplant well. Thin out the young plants 25-30 cms. apart. Water only enough to keep the soil just moist. Grow them fully exposed to sun. Keep removing seed pods to prolong the period of bloom. For cut flowers, gather the blooms, when they are only half expanded, before the heat of the day. Immediately after cutting, place the stems for a minute in a bowl of boiling water, taking care the steam does not reach the delicate flowers. Treated this way, the flowers last much longer.

Portulaca. (*Portulacaceae*): *Portulaca grandiflora* is a very pretty low growing annual with a trailing stem with short thick leaves of the thickness of a broomstick, bearing, in great profusion brilliantly coloured flowers, 2 cms. or more across. The flowers resemble Roses in form and are single or double. They open out at about 9 a.m. and close at about 3 p.m. and wither away in a short period. Mix the seeds which are very small with four times the quantity of fine sand to ensure uniform and even sowing. Sow where the plants are wanted to grow or in seed-pans and transplant carefully when ready. Water with a fine rosed can. *Portulaca* thrives well in sandy soil in open sunny situation. Do not allow the soil to get dry at any time but do not keep it wet either. Sunny situation and careful watering with a fine rosed can and fine mellow soil are all the essentials for successful culture of this lovely annual. It is usually grown in shallow seed-pans with four to five plants in each. The soil in the pans is covered lightly with broken bricks to prevent the leaves from rotting by coming in contact with wet soil. It is very serviceable for edging large plants in tubs and vases. H. 15 cms. B. 3½-4 months. (S. C.)

* **Primula.** (*Primulaceae*). (Primrose): This genus is a very large one including as many as 150 species but the florist's flowers, viz., the *Primula auricula*, *stellata*, *obconica*,

japonica and *sinensis* are the only garden favourites. They are handsome, delicate, pretty in leaf and in flower and continuously bloom for nearly two months at a time. They are small herbaceous perennials, bearing their showy flowers which are either single or double, in clusters or trusses on stalks 15–30 cms. high. But, they are treated as annuals and raised from seeds each time. They thrive only from medium to high elevations. The new strain *P. malucoides* may be grown in semi-shade in the plains in the cool season. In the plains the seeds may be sown during September and October, and on the hills, from March to May. They are plants eminently suited for pot-culture. The seeds are very small in size. To sow them, fill the seed-pan to 1.25 cms. from the top with fine sifted soil containing a large quantity of leaf mould or thoroughly well rotten old spent manure; leave the surface rather rough and sprinkle the seeds, previously mixed with fine sand, thinly upon it, not covering with soil. Water the pan from below, by standing it in a basin of water. Cover the surface of the soil with paper tied round the pot and then place the pot over a hot bed, failing which in a warm shady situation. Keep the soil moist by watering the paper only and if necessary, by watering it from below also, as described above. In two to three weeks, germination takes place irregularly; and when the seedlings are big enough to be transplanted with ease, pot them singly in 7.5 cms. pots and shift them to pots, 5 cms. bigger in size, as the pots they are in get filled up with roots, till they are finally put into 20 cms. pots. A rich loamy soil suits them best. Give them only so much water as is absolutely required by them. A shady situation is very necessary for successful culture of these plants. If the old plants are healthy, repot them in fresh soil and they will flower again.

Reseda odorata. (*Resedaceae*). (Mignonette): A great favourite with many on account of the sweet fragrance of the flowers, which are not particularly attractive. The plants grow into bushy specimens, if pinched once or twice, before flowering. H. 20–45 cms. Flowers, which are in white, yellow, crimson or red shades are produced, 3–3½ months after sowing, in tall erect racemose spikes. Mignonettes are

very delicate plants and do not stand transplanting. Hence, seeds should be sown, where the plants are wanted to grow and seedlings thinned out 10-30 cms. apart. Well prepared sandy loam with some old mortar added to it, is the soil best suited for growing this annual. Mark rows 20 to 30 cms. and drop at the intersection of the rows, about three seeds and cover them lightly. For pot culture, sow thinly in 25 cms. pots filled with the soil required and thin out seedlings, retaining three of the strongest ones. Or, grow one plant in a 16 cms. pot. Water with especial care particularly at the initial stages of their growth. Shade them from afternoon sun. Provide wire supports to them as they develop. The side growths at the top may be removed when the flower heads show themselves up. Two or three side growths at the bottom may be retained for a second crop of flowers. B. 3-4 months. (C).

* **Rudbeckia.** (*Compositae*). (Cone Flower): Herbaceous perennial plant like the Michaelmas Daisy, bearing large, showy, bright yellow, ox-eye, daisy-like, long stalked flowers. There are hybrids available in other colours too. Plants are useful in borders and flowers are useful for cutting. Grows easily in any good garden soil without care. Renew old with fresh plants raised from seeds. Flowers freely only at medium to high elevations. Also raised by division of clumps. The annual varieties, especially *bicolor superba*, golden yellow with dark centre can be grown with success in the plains. H. 30-45 cms.; D. 50 cms.; B. 4-5 months.

* **Saintpaulia.** (*Gesneraceae*): Called after the discoverer of the plant, Baron Walter von Saint Paul. *S. ionantha*, the species grown in our gardens, is popularly known as the African or Usambara Violet. It is a small herbaceous perennial plant of great beauty, fit for decoration of the conservatory and growing on rockeries in shade. The plant is almost stemless with a rosette of long stalked ovate hairy leaves, resembling those of Gloxinia, to whose family this plant also belongs. The flowers are coloured deep purplish violet and resemble violets in shape though in size they are much larger. Throughout the year, the plant flowers freely. Saintpaulia is best grown in well drained small 12 cms. pots and then

shifted to 20 cms. pots or in shallow pans in a light rich soil composed of two parts of fine sand, two parts of sifted leaf mould, one part of friable soil, and one part of horse manure, which is well decomposed and sifted. The soil should be covered with a layer of broken bricks so that the fleshy leaves may not come in contact with the soil and rot. Protection from severe sun should be provided for the plants. In summer, care has to be exercised in watering, as excess of moisture causes the leaves to damp off. Propagation is by seeds, which are very small and are sown like Begonia seeds, and also by cuttings of leaves. The latter is the simpler and the easier method. Mature leaves, which are not over-ripe are cut off with 2.5 cms. of the stalk and inserted in sand in such a way that the stalk with the base of the blade is under the soil. See illustration on page 77. The cuttings are carefully watered neither keeping the sand very wet during the process of rooting nor allowing it to get too dry at any time. The rooted cuttings are then transferred to 12 cms. pots as stated above.

Salpiglossis. (*Solanaceae*): (Velvet Flower). Beautiful annual, $\frac{1}{2}$ metre. tall, with clammy leaves and stems and bearing gorgeously beautiful Petunia-like but smaller velvety single flowers, which show a variety of colours unsurpassed by any other flower. The flowers are usually beautifully marked and pencilled with several colours and they never fail to please the eye. In the plains, Salpiglossis does not come up so well as at medium to high elevations, where it can be grown in beds. Grow 3 plants in a 25 cms. pot. (C)

* **Salvia.** (*Labiatae*). (The Sage Family): The genus comprises of mostly herbaceous perennial plants and subshrubs, which are mostly natives of Mexico, Brazil, and Central America. Some species, as the Common Sage (*S. officinalis*), the Clary (*S. sclarea*) and (*S. horminum*) are of immense economic importance, as their leaves are of medicinal value and are useful for seasoning. There are several ornamental species which make excellent bedding, border and pot plants. Variation in Salvias within the generic limits is something very astonishing; the habit of growth varies from 15 cms. to 1 $\frac{1}{2}$ metre; the colour ranges from deep scarlet to

purple, violet to azure blue, white to light yellow and pink and rose; the form of flowers also varies, some flowers gape wide open while others are nearly long and tubular; in some species, the colour of the calyx and corolla is the same while in others, they are of different colours. Almost all the species are hardy. The species which are best suited for the plains are *S. splendens* and its hybrids and *S. farinacea*. Others thrive from medium to high elevations only. Salvias can be easily propagated from cuttings and by division of clumps in some kinds but they are best treated as annuals, being raised from seed, each time. Seedling plants are more vigorous and floriferous. Sow seeds thinly in seed pans or in nursery beds. When the seedlings are sufficiently large prick them in light rich soil 5 cms. apart. When the leaves of the adjacent seedlings touch each other, pot them singly in 12 cms. pots or plant them out in beds 30-60 cms. apart according to the variety. Pinch the tops of the plants for bushy growth. Transfer the plants from 12 to 20 cms. pots, as the former get filled with roots and finally shift to 30 cms. pots, using compost No. 1 page 126. Water the plants liberally during vigorous growth and feed them with weak liquid manure of any kind once a week. They remain in bloom for 1½-2 months or more and they would flower again if the shoots, which have finished flowering, are cut back and the soil is top dressed with rich manure. The following are a few of the noteworthy species:—

* *S. splendens* or the Scarlet Sage is the most widely grown Salvia. It is very attractive, with numerous large erect racemes of bright scarlet flowers, appearing well above the dark green foliage. It is very useful for massing in large beds and along borders and it enjoys bright sun-shine. Varieties of *S. splendens* are many and attractive. They are of different colours and in some kinds, the colour of the calyx is different from that of the corolla. It is the hybrids of *S. splendens* that make up the attractive displays of Salvias in the Flower Shows at Bangalore. *S. splendens plumosa* is a new introduction. Flower spikes are massive and compact, looking like those of *Celosia plumosa*. A very handsome variety. H. 45-60 cms. ; D. 45 cms. ; B. 4 months.

S. fulgens (Syn. *S. cardinalis*) is similar in habit of growth to the preceding species.

* *S. farinacea* is also a much grown species; a free flowering perennial, $\frac{1}{4}$ – $\frac{3}{4}$ metre high, with branches from top to bottom, bearing large long spikes of small lavender blue flowers. The white flowered variety is also handsome. *Farinacea* "Blue Bedder" is a great favourite bedding kind.

* *S. azurea grandiflora* $\frac{1}{4}$ – $\frac{1}{2}$ metre high; azure blue spikes of flowers; leaves small; plants produce number of suckers from which propagation is easy; easily raised from seeds also.

S. leucantha is a pretty straggling shrub, about $\frac{3}{4}$ metre high with silvery herbaceous stem and linear acuminate leaves which are dull green above and silvery beneath. The flower racemes are elongated and are about 25 cms. long. The individual flowers are small and are light purple and white in colour, the calyx and the corolla being coloured differently. Excellent for growing in small tubs and in long borders.

S. Grahamii is a shrub, $\frac{1}{2}$ metre. high, with elongated racemes, more than a 30 cms. long; colour of flowers, deep crimson. A pure white variety of this species is charming.

* *S. involucrata* variety *Bethelli*. $\frac{1}{2}$ metre high; has large cordate oval leaves and bears brilliant large rosy crimson flowers, tipped white, in large terminal whorled spikes. Very pretty. Makes a very a good pot plant.

S. coccinea (Syn. *S. rosea*). $\frac{1}{4}$ – $\frac{1}{2}$ metre high; long erect spikes of small crimson scarlet flowers; varieties with white, pink or coloured flowers are available.

* *S. patens*. $\frac{1}{4}$ metre high; the flowers are loosely arranged in the racemes. They are very attractive, being deep blue in colour and very large in size; the calyx is campanulate and the corolla is broadly tubular and 5 cms. or more long. Forms tuberous roots. There is a white flowered variety.

* *S. uliginosa* is a pretty shrub, producing suckers from below in plenty, growing to $\frac{1}{2}$ – $\frac{3}{4}$ metre high, bearing spikes of blue flowers. Very good for border. Requires a large pot for cultivation.

S. rutilans grows. $\frac{1}{2}$ metre high bearing red flowers.

Leaves are Pine-apple scented.

S. pratensis bears violet flowers. H. $\frac{1}{2}$ metre when in bloom. White and rose coloured varieties are also available (C.R.S.)

Saponaria. (*Caryophyllaceae*): *Saponaria calabrica*, called popularly the Soap-wort, is an annual of low growth, about 30 cms. tall, producing small star-shaped flowers of pink or rose colour, in great abundance. Effective for edging larger plants and also in beds. (C).

Scabiosa. (*Dipsaceae*). (Pincushion Flower): Also known as Mourning Bride. Hardy biennial raised from seed every year. H. $\frac{1}{2}$ - $\frac{3}{4}$ metre. Large handsome globose heads of flowers are produced on long stalks, about 45 cms. tall. Flowers are useful for cutting. If picked when nearly open and the ends of the stems just burnt, they will last in water for several days. Best grown in the ground 35-45 cms. apart. (C).

***Schizanthus.** (*Solanceae*). (Poor Man's Orchid): One of the best cold season annuals, suited for medium to high elevations growing 30-45 cms. high, with very pretty cut foliage of a light green colour and bearing sprays of orchid-like flowers of varied colours, from which, it has obtained the name Butterfly Flower or Fringe Flower. *Schizanthus* is available in varied shades of colours and in various markings and combinations. *S. Wisetonensis* is a strain with very large and showy flowers, usually grown in pots only. The *hybridus grandiflorus* strain is better suited for growing in open ground. Acclimatised seeds give best results at medium elevations. Sow seeds thinly in light soil or seedlings damp off. Seeds take 10-20 days to germinate. When they show 3 or 4 leaves, transplant carefully. Shift to 7.5 cms. pots and finally to 20 cms. pots. Stop once or twice for bushing out. Stake, as the stems are very fragile. Protect from wind. Best grown on hill stations with a prolonged cold season. (C).

***Solidago.** (*Compositae*): A genus comprising of many species of the well-known Golden-Rods. They are coarse growing but ornamental herbaceous perennials, growing $\frac{1}{2}$ to 1 metre tall, producing erect feathery rodlike trusses

crowded with pretty golden yellow flowers. Though natives of temperate climates, they do well under tropical conditions. They are hardy and thrive in any good garden soil and a sunny situation though they may be grown with satisfaction in semi-shade. They are raised by suckers as Michaelmas Daisies and grown like them. Golden-Rods are suitable for mass planting in beds and borders in and adjoining lawns. There are several attractive species.

Spider Plant. See under *Cleome*.

***Statice**. (*Plumbaginaceae*). (Sea Lavender; Sea Pink): Several species with everlasting flowers, used for cutting. *S. Suworowi*, an annual growing to about 45 cms. bearing bright rosy pink long branching spikes of flowers. Flowers are 'everlasting'. B. $3\frac{1}{2}$ -4 months. Grow in pots or in ground. D. 20-30 cms. *S. sinuata* has sinuate basal leaves, grows 30-45 cms. tall, and is available in varieties with blue, rose, white and lavender colours. *S. Bonduelli* bears yellow flowers.

Stock. See under *Mathiola*.

Streptocarpus. (*Gesneraceae*). (Cape Primrose): They are difficult to grow in the plains but do well from medium to high elevations. They are attractive perennial stemless herbs with one or more prostrate radical leaves, bearing erect scapes of large showy blooms of blue, lilac, mauve, white or pink. Hybrids are very large flowering and show diversity in colours. *Streptocarpus* are suited for pot culture and for planting on rockeries in shady situations. Raised from seeds, they take 8-15 months to flower. Seeds are very minute in size and should be sown with the usual care necessary with such seeds. Select kinds can be propagated by division or by leaf-cuttings. Discard old plants after flowering.

Sun-Flower. See *Helianthus*.

Sweet Pea. See *Lathyrus odoratus*.

Sweet Sultan. See *Centaurea moschata*.

Sweet William. See *Dianthus barbatus*.

***Tagetes** (*Compositae*). (Marigold): Well known, easily grown annuals which are very useful for massing in beds and for planting in mixed borders and for pot culture. Flower heads vary in size from the size of a button to 10 cms. across

and they are in shades of yellow or orange. Some new red kinds are also available. Rich soil and plentiful supply of water are two essentials. Almost all the kinds have gracefully cut pretty foliage, which in some kinds is peculiarly scented. There are several varieties detailed in catalogues and one may easily choose from them the particular kind for any particular purpose, viz., for bedding, for border, for edging, for individual planting etc. *Tagetes* is divided into two groups, based upon habit of growth. *Tagetes erecta* and *T. lucida* constitute the African Marigolds and they have a tall and upright open habit of growth and are not quite as well suited for bedding purposes as the French Marigolds. They are however better suited for border planting. Flowers are immensely double, often measuring 20 cms. in circumference. Colours are shades of yellow and orange. Sow seeds in nursery beds and plant out 45 cms. apart. *Tagetes patula* and *T. signata* constitute the French Marigolds and they have a spreading habit of growth, making bushy plants, the branches often lying close to the ground. They are compact bushes with a mass of foliage and innumerable flowers, single or double, in yellow or orange or red tinted variegated colours. Flowers are comparatively much smaller than in the African type but this is compensated by the larger number of blooms produced. French Marigolds are very satisfactory bedding plants with a long period of bloom. They are also very rapid flowering excellent pot plants. The dwarf or 'nana' kinds are very useful as edging plants. Start them in small pots and set them 30 cms. apart. *T. signata pumila* are lovely compact little plants, 15-25 cms. high, studded with golden orange flowers; very useful for edging. The Australian giant tree Marigold varies from the French and African Marigolds, grows to 1½-2 metres in height bearing flowers nearly 12 cms. across and of golden brown colour. Best suited for planting as isolated specimens. For group planting, distance apart should be 1 to 1½ metres. Late blooming. Overmanuring the bed will result in luxuriant foliage at the expense of flowers. (R C).

Tahoka Daisy. (*Compositae*): A fine decorative plant, about 50 cms. high, of fairly bushy and compact habit, with

deeply lacinated or fern-like foliage. Flowers, nearly 5 cms. across, daisy-like and composed of a single-row of narrow, pointed, lilac blue petals, surrounding a central disc of deep golden yellow and borne on long stems and hence ideal for cutting. Easily raised from seed, flowers early, and has a prolonged blooming period.

* **Tithonia**. (*Compositae*): Popularly known as the Mexican Sun-Flower, *Tithonia speciosa* is a showy annual, growing 1-1½ metres tall, and bearing in profusion orange-scarlet flowers provided with long stalks and useful for cutting. It is easily grown, thriving well in light, richly manured soil. Sow seeds in nursery-beds and transplant seedlings ½ metre apart. Flowers within three months after sowing and is valuable for planting in long borders and in shrubberies. (C.S.R.)

* **Torenia**. (*Scrophulariaceae*): Profuse flowering annuals and perennials, very useful for massing in small beds, for edging larger flowering plants in flower beds, for hanging baskets, and as window plants. They are excellently suited for pot culture too. *Torenia Fournieri* is one of the handsomest of annuals. The common kind is bright purplish blue in colour with a golden yellow throat. There are other varieties with light purple, light blue, yellowish white, and almost pure white colours with a different colour in the throat. *Torenia*s can be grown throughout the year. Seeds are sown where they are wanted to grow and the seedlings thinned out 22 cms. apart or seeds may be sown in seed pans and the seedlings transplanted when ready. To make bushy and satisfactory plants, it is essential that the plants should be stopped twice or thrice. The duration of blooms is nearly two months. *T. flava* (syn. *Bailloni*) is a handsome species bearing golden yellow flowers with dark maroon eye. It has a slight trailing habit and is not quite as suited for the plains, as the preceding species, where it can be successfully grown only in cold season. * *T. asiatica* is a dwarf trailing herb, a perennial, a native of the Nilgiris. It makes a very fine plant for hanging basket and for carpet beds, the foliage covering the soil and the brightly coloured flowers displaying themselves above the foliage. Though the species is a

perennial, still it is desirable to treat it as an annual as it only takes about five months to flower from seed. It can, however, be easily raised from cuttings. (R.C.).

* **Tropaeolum.** (*Geraniaceae*) (Nasturtium): The genus comprises of some of the best annuals we have in existence, *Tropaeolum minor* is the dwarf Nasturtium. It is a very hardy, popular, effective bedding annual, growing 20-30 cms. high, with long stalked roundish, attractive leaves, and bearing very brightly coloured queer looking large flowers in great profusion throughout the season. Nasturtium grows without care in any garden soil, by sowing the large seeds where they are wanted to grow. Too much manure in the soil makes the plants run into leaf at the expense of flowers. Sow seeds 15 cms. apart in beds and thin out a 30 cms. apart, if there should be overcrowding. The extra plants may be used for filling other beds, Thin out such foliage as hide the flowers. If plants show a tendency to weaken and slant, steady them by earthing up soil round the stems. Flowers are borne within 2½ months of sowing. Of late, Nasturtiums are very much improved. The Dwarf Double Nasturtiums are compact bushes of globular form, about 30 cms. high and 45 cms. across, bearing gorgeous giant double or semi-double sweetly scented flowers freely on long stems. These attractive plants are eminently suited for bedding, edging, rock work, and pot culture. The semi-tall Gleam hybrids produce large exquisitely sweet scented semi-double and double flowers in plants of vigorous growth and splendid for broad borders, bedding, and ground cover. (R C).

Tropaeolum majus is the tall or climbing Nasturtium. It can be used as a bedder by pegging down the shoots and as a low climber for windows or screens. It is easy to grow and resembles the dwarf Nasturtium in every way except that it has a climbing habit of growth. This kind does not thrive at low elevations.

T. aduncum, the Canary Creeper is a pretty climber about 2 metres high, bearing beautiful canary yellow flowers in profusion. It does not thrive in the plains.

Perennial species of *Tropaeolum* can only be grown on the Hill stations.

Ursinia anethoides. (*Compositae*): South African summer annual, about 45 cms. high, with finely cut foliage, and bright orange yellow daisy-like flowers with purplish centre. The flowers are attractive and excellent for cutting and produced over a long period. Seedlings do not transplant well. Does not thrive in the plains.

Venidium fastuosum. (*Compositae*): Showy annual from S. Africa, $\frac{1}{2}$ – $\frac{3}{4}$ metre high, with large daisy-flowers, 7-10 cms. across, of bright vivid orange with a black-purple zone at the base of the ray petals surrounding a dark centre. Well drained soil, sunny situation and careful watering needed. Useful for growing in summer. Not suited for plains.

Verbena. (*Verbenaceae*): The garden Verbenas are every popular trailing plants 15 to 30 cms. in height, of a perennial habit but grown as annuals each time from seed though they can be very easily propagated from cuttings and layers. Special and attractive kinds are best propagated by vegetative means as plants raised from seed may not come true to the parent. Verbenas strike root as the shoots trail along the surface of the soil wherever they come in contact with moist soil. Hence to propagate them, peg down the shoots as they creep along at different places and separate the rooted portions of the shoots from the parent and grow them independently. Verbenas are very serviceable as ground cover under tall plants, and in the shrubberies, for hanging baskets, for rockeries, for growing in beds and for pot culture. The following species are grown:—(i) * *Verbena hybrids*. (ii) * *Verbena erinoides*, and (iii) *Verbena venosa*. (C.S.R.)

There are very few flowers which can beat the *Verbena hybrida* in the exquisite range of colours, varying from white through blue and rose to purple and dark purplish blue, with shades of pink and pale yellow. Flowers are produced in very great profusion well above the foliage in large velvety clusters which are often 10 cms. across. The flower clusters are of the finest form and have in many kinds a delicate sweet scent. The hybrids may be conveniently classified under three heads, according to the colour of the flowers:—(a) Selfs are one coloured varieties. (b) Oculatas are eyed varieties, the centre of the flower having a different colour from the rest of the flower

and (c) Italian striped varieties with their petals marked by bands of two different colours. Sow the seeds, which look like small bits of cut straw, in seed-pans. Transplant the young plants twice, before they are finally potted or planted out. Space them a 30 cms. apart each way in the beds, though the plants will very well cover over 90 cms. of ground in course of time. Do not overwater them as they are very impatient of wet. On account of this reason, they are sometimes grown in raised beds. As the plants grow, lead the shoots to bare spaces in the ground and peg them down with small unobtrusive bamboo hooks so that the plants may cover the beds well and produce a mass of bloom. Pinch the tops of the shoots for bushy and compact growth, till six weeks before the flowers are desired. Remove all flower buds till the plants cover the pot or the beds well. Verbenas are gross feeders and hence top dress with manure mixed with loam. The manure should be well forked into the soil. Apply liquid manure once in 15 days.

Verbena erinoides is known as the Moss Verbena, as the plants cover the ground closely as moss. The leaves are small and graceful and the flower clusters though small, are produced so freely and so very plentifully, that the bed looks a carpet of light mauve which is the colour of the commonest variety. Lately the pink, pure white and white variegated with purple are introduced, but latter kinds are not quite as hardy as the lilac or the purplish kind. Moss Verbenas are excellent plants for growing under standards along walks in narrow long beds or in small round or oval beds. These are easily raised by separating rooted portions from beds. After the flush of bloom is over, cut the plants to the level of the ground, thin them out 22 cms. apart and fork in plenty of manure mixed with a little garden soil. Water regularly and again within 2½-3 months the bed is a mass of bloom. Dig the beds once a year and replant them.

Verbena Royal Bouquet is especially good for pot culture, as the flowers are borne upright. They are in large heads as in *V. hybrida*, available in many colours and are mostly auriculæ-eyed. *Verbena venosa* is less showy than the hybrid kinds and bears purple flowers. It is a distinct kind

with stiff leaves and paniced inflorescence and tuberous roots. It is serviceable in mixed borders and for edging. National Botanic Gardens Lucknow, have evolved numerous varieties of Perennial Verbenes in enchanting shades of colours.

Vinca. (*Apocynaceae*). (Madagascar Periwinkle): *Vinca rosea*, and its varieties with pure white flowers, with or without reddish eye in the middle, are hardy perennial plants growing to a height of about $\frac{1}{2}$ metre. They are furnished with neat attractive foliage of polished smooth green leaves and bear the flowers freely throughout the year. The Vinca is called in Tamil, "Sudukadu mallikai" (the Burning ground or Grave-yard Jasmine). The plants should be cut back every four months. They are useful as pot plants, in beds and in borders and on open rockeries; easily raised from seed, also by cuttings. (C.S.R.).

***Violet.** (*Violaceae*): The Violet is one of the choicest garden flowers. The plants are small herbaceous perennials, which are propagated by runners which are developed in abundance. The flowers are provided with long stalks and are eminently suited for cutting and, for button holes, being very sweet scented. The available colours are white, pink and violet. The flowers are single or double. The cultivated species are derived from *Viola odorata*, which is widely distributed over Europe and Asia. Violets are natives of the temperate climate and hence can only be grown in the plains as seasonal plants. In the plains, the plants do not flower freely and the size of the blooms is comparatively small. Any good garden soil suits them but sandy loam is most agreeable. Violets are usually grown in seed-pans, three plants being put in each pan. They can also be grown in well prepared beds. They abhor a dry spot and love a cool and moist one, under the shade of large trees or in a border exposed to morning sun only. The soil should be deeply dug and the addition of wood ashes contributes to good results. Watering should be regular and the beds should be hoed frequently. Of the diseases and pests to which Violets are subject are leaf spots, stem and root rots, red spider, green bugs and aphides. See Chapter XI for remedies. Good cultivation, ventilation, proper watering and careful picking

off of affected leaves, etc., are some of the points that will have to be attended to for success. Propagation is by one of two methods:—(a) After the plants have finished flowering, lift them out of the soil, shake off the soil and pull them into several bits, each bit having some root system of its own. Pot them in small 10 cms. pots singly or start them in seed pans. By this method, some plants do not come out well as the woody and hard stems do not root freely and do not make satisfactory plants; (b) Select young and vigorous offshoots, separate and root them in sand as cutting. This is the better of the two methods of raising Violets. Choose suckers from plants that flower well. After the suckers have established themselves, pot them singly in 15 cms. pots or three in a seed-pan in a compost composed of one part of sand, one part of loam, and two parts of well rotten horse manure. Remove the runners as they come up. Keep the soil open by frequent stirring. Water regularly keeping the soil moist always. Do not expose the pots to continuous rains. A dressing of half decomposed horse manure acts as a stimulant applied before flowering.

* **Zinnia.** (*Composiate*): The Zinnia is a very popular Mexican annual, varying in height from 15 cms. to 1 metre. and more, with stem-clasping ovate leaves and very attractive single or double flowers of various colours in several shades. There are very few flowers which are so easily grown from seed in the open ground or bloom so very abundantly and continuously for quite so long a time as Zinnias. They combine richness and diversity in colour with profusion and duration of bloom. They have been very much improved in recent years and are available in quite a large number of desirable strains. All of them can be grown throughout the year. (R. C. S.).

Zinnias are effective, planted in beds by themselves. The taller kinds are useful in the border. The very dwarf kinds as *Z. linearis* are useful for edging.

The following are some of the best types and strains of Zinnias:

The *Dahlia flowered Zinnias* grow $\frac{1}{2}$ – $\frac{3}{4}$ metre high, make robust plants bearing many strong stems with fully double huge flowers 15–20 cms. in diameter, resembling the

show type of Dahlias. The *Californian Giants* are taller growing than the preceding type and produce very attractive fully double flat flowers on long stems. The *Fantasy Zinnias* grow to about $\frac{1}{2}$ metre and bear well rounded medium-sized double flowers, 7 to 8 cms. across and composed of tubular twisted petals, such as those in shaggy Chrysanthemums. The *Scabiosa flowered Zinnias* grow $\frac{1}{2}$ - $\frac{3}{4}$ metre tall and bear flowers 6-8 cms. across, resembling the annual Scabiosa or Marigold Harmony. A defect in this type is that the flowers do not all come true to parent. The *Striata* type of Zinnias bears medium-sized flowers, interestingly striped, on plants $\frac{1}{2}$ - $\frac{3}{4}$ metre high. The *Cut-and-Come-Again* (elegans pumila Dwarf Double) Zinnias bear well rounded medium-sized flowers about 6 cms. across, very freely borne on long stems. The plants are compact and branching and grow to about 45 cms. high keeping on blooming over a long period, making an attractive display in beds or borders. The *Liliput* or *Pompon Zinnias* bear most exquisite and appealing fully double pompon-like flowers 2-4 cms. across. They grow 30-40 cms. tall and are excellently suited for beds and borders. *Cupaid Zinnias* are dwarf, 30 cms. high, well formed plants with small button-like fully double flowers, not exceeding $2\frac{1}{2}$ cms. across, borne in plenty over quite a long period. Suited for beds, borders and rock gardens. The *Haageana Double (Mexican) Zinnias* produce freely small colourful blooms, 2-4 cms. across, in a remarkable range of colour blends and combinations on plants, 30-45 cms. tall. The *Tom Thumb Zinnias* grow up to neat compact plants, 15-25 cms high, bearing early well formed double flowers, 2-5 cms. across. *Zinnia Thumbelina* is a half hardy very dwarf annual grows to only 15 cms. and bearing beautiful flowers as big as 5 to 8 cms. and makes a neat compact bush.

For growing Zinnias, a richly manured soil and sunny situation are necessary. To get the best satisfaction, imported seeds should be secured every now and then, as Zinnias degenerate raised from acclimatised seeds continuously. D. 20-45 cms. according to the type and the habit of growth. In the large double flowered kinds, the first flower bud should be cut away, as it generally produces an inferior

flower. As plants have a tendency to rush into flower, pinch the tops of the shoots to bush them out. Cut away all the small and inferior flowers leaving only the large ones for making good seeds.

Z. linearis produces small single bright yellow flowers enveloping the plants in a mass of colour. H. 20-30 cms.; D. 20-30 cms.; B. $2\frac{1}{2}$ months. Very pretty in beds by themselves or edging taller plants. There is a white variety of this also.

CHAPTER XXVI

BULBOUS PLANTS

The term 'bulbous plants' as used in horticulture, embraces such botanically distinct plants as those bearing bulbs, tubers, corms, rhizomes, pips and fascicled roots. They are all seasonal plants with underground modified stems containing a store or food and energy for the development of the seasonal aerial shoots of stems, leaves and flowers. The true bulb is of two kinds; it consists of modified fleshy leaves folded round each other as in the *Amaryllis* and the onion or it is made of scale-like narrow thick leaves overlapping each other like the tiles of a roof as in *Lilium*. A tuber is a thickened modified underground stem bearing buds in the axils of scale-like leaves developing into new growths, as in *Achimenes* and the Potato. A corm is a solid tuber developing offsets, as in *Gladiolus*, from which it is grown. A rhizome is an underground creeping stem bearing roots below and aerial shoots above carrying flowers and foliage. *Canna* and *Ginger* are best examples of rhizomatous plants. The *Dahlia*, though it bears fleshy roots, is not a tuber, as it cannot be grown into a plant from the fleshy root itself without a portion of the stem with a bud attached to it.

True bulbous plants are characterised by three stages in their growth, *viz.*, the blooming, the growing and the resting periods. When the plants are growing actively, the leaves and stems send down to the underground part, nourishment which is utilised to thicken the latter and is stored in it. After a period of vigorous growth, the foliage becomes yellow and dies down along with the shoots. From this time onwards till the bulb again starts growth by swelling its buds and pushing out its aerial shoots during the growing season, the bulb enjoys rest and is dormant, being dead to all outward purposes.

The other kinds of 'bulbous' plants, which are not true bulbs, also experience a period of rest after a period of

activity, though not so markedly. There is a certain amount of lack-lustre appearance and cessation of active growth during a certain period. Resting period for bulbous plants may be said to be from November to March generally, varying with climatic conditions in different places.

Bulbous plants are grown for their flowers or foliage or both. There are a number of them, varying in habit of growth, form, colour, etc., so that some are available for massing in beds as the Canna, some for border planting as Dahlia, Crinum and Amaryllis, some for hanging baskets as Freesia and Achimenes, some for growing on lawns in patches here and there brightening them as Cooperanthes and Zephyranthes, some furnishing excellent flowers for cutting as Gladiolus, Iris, etc. For pot culture, Gloxinia, Achimenes, Dahlia, Begonia, Caladium, etc., are eminently useful.

The time for planting different kinds of bulbs differs in different place in India. The time of planting the same kind of bulb at low, medium and high elevations also differs. Dahlia for instance, is planted in Bangalore early in June to bloom in August; in Madras, it is planted in November or December. The time for planting is best determined by the time when the particular bulb naturally blooms in the particular place.

While all bulbous plants generally thrive on hill stations, there are some kinds which do not thrive and bloom at medium elevations and many which will not do at low elevations. Anemone, Begonia, Belladonna Lily, Crocus, Daffodil, Hyacinth, Clivia, particular species of Gesnera, several species of Iris, Isoloma (Tydaea), Ixia, Kniphofia, Liliun, Montbretia, Narcissus, Ranunculus, Saxifraga, Watsonia, Tulip, Tigridia and Sprekelia—these can best be grown only on hill stations, 1000 - 1500 metres above the sea. At medium elevations some imported bulbs of some of the above kinds may thrive, such as Anemone and Ranunculus but they perish after blooming for one or two years. Only the following kinds can be grown at lower elevations:—hardy purple types of Achimenes, Amaryllis (the ordinary kinds with red and white colours), Canna, Crinum, Alpinia, Costus, Caladium, Alocasia, Colocasia, Dahlia, Eucharis,

Eurycles, Gladiolus, Gloriosa, Haemanthus, Hemerocallis, Hedychium, Kaempferia, Mirabilis, Oxalis, Pancratium, Polianthes tuberosa, Zephyranthes, Heliconia and Maranta. To the above list may be added, the following, for growing at medium elevations, that is, from 600 to 1000 metres:— All varieties of Achimenes, Agapanthus, Amaryllis hybrids, Arisaema, Begonia, Belamcanda, Calla, Clivia, Costus, Cyclamen, Freesia, hardy kinds of Gesnera, Gladiolus, Gloxinia hybrids, some hardy species of Iris, some kinds of Liliums for one or two years, Montbretia, etc.

Bulbs for growing at medium elevations and on hill stations are got out from England, Holland and Germany and sometimes from U.S.A. Bulbs for low elevations are best got out from Australia, as the flowering season there corresponds with that in Madras and such places. Otherwise, the bulbs from the Continent should be kept by and potted only next year.

The general method of cultivation of bulbous plants is almost the same. After the resting period, take out the bulbs and place them in moist sand. The dormant buds swell and push out the shoots. When sufficient growth is made—this may be from $\frac{1}{2}$ to $2\frac{1}{2}$ cms. according to the kind—pot the bulbs or plant them out as the case may be. The soil should be sandy loam rich in leaf mould. Do not place any fresh manure immediately in contact with the bulb. Compost No. 3 on page 126 is suited for most kinds for pot culture. Drain the soil effectively and in the case of pot plants, provide them with more than the usual quantity of drainage material at the bottom of the pots. The depth to which bulbs should be planted varies with the kinds. Plant Amaryllis, Haemanthus, etc., in such a way that their growing tip or crown is just above the soil; cover Gladiolus bulbs with a 5 cms. depth of soil; some Lilies as *L. tigrinum* and *L. speciosum* emit roots from the stem above the bulb in addition to those which are produced below; plant such bulbs sufficiently deep—as much as 12–15 cms. of soil may be necessary above the bulb—to encourage the formation of the upper set of roots also. Non-stem-rooting Lilies may be planted 5–7 cms. deep according to the size of the bulb. On hill stations,

bulbs like Hyacinth and Tulip are planted 7-10 cms. deep, generally to their own depth of soil. Pot or plant the bulbs early in the season so that they may have as much time as possible to grow. To facilitate early and easy rooting and to prevent rotting, put a handful of sand all round the bulbs while planting. Make the hole for putting the bulb in the soil with a trowel and not with a dibber, otherwise, the bulb would not rest on soil but would get stuck up in the hollow of the soil and would rot soon. Soon after planting, water copiously and sparingly thereafter till the bulbs are rooting and have begun active growth. Increase the supply of water as more and more growth is made. Stake the plants as they grow. Apply liquid manure prepared from cow or horse-dung once a week or ten days from the time the buds are forming to the time the buds open. Avoid artificial manures as they are likely to do more harm than good with the least indiscretion in their use. When the growing season finishes, the leaves begin to turn yellow and the leaves and the shoots begin to die down. Then on, decrease the supply of water. Stop watering altogether when the shoots have died down completely. Do not cut away the shoots and leaves; let them die down naturally. Then toss the bulb out of the pot or dig it out of the ground carefully and allow it to lie in a cool and shady place for a few days till the excess of moisture associated with the soil evaporates away. Then remove all earth from the bulbs and put them in dry sand in a cool place in such a way that the bulbs do not touch each other. Examine them occasionally to see if any rot has set in to prevent infection. Cut away clean the rotted portion and dip the rest in charcoal powder. If the bulb is too badly damaged, throw it away.

Bulbous plants are propagated by offsets, in the case of such kinds as Tuberose and Amaryllis which produce offsets, from cuttings of portions of tubers with growing buds on them as Caladium and Potato, by spawns or little entire corms attached to large corms as in Gladiolus, or from seeds, from which it takes more than three years generally to bloom. The methods by which the several kinds can be propagated are mentioned under their respective heads. Also see pages 88-89.

Bulbous plants are a hardy lot and they suffer from very few pests and diseases. The black caterpillar is the only formidable insect pest. It should be handpicked when it appears. Some times roots rot on account of fungus developing from cut surfaces of tubers or injured spots. These should be dusted with sulphur powder before planting. Below are two lists of plants:—(A) Select Bulbous Flowering Plants, and (B) Select Bulbous Plants grown for their ornamental foliage.

(A) SELECT BULBOUS FLOWERING PLANTS

***Achimenes** (*Gesneraceae*) : Tropical American small plants, 15–30 cms. high, producing in the rainy season a constant succession of effective flowers of great variety in form and colour. Flowers are long and tubular or have a more or less flattened limb; the former are known as the longiflora type and the latter grandiflora type. Tubers are scaly and brittle; they are pear-shaped borne at the ends of the roots or caterpillar-like and clustered under the stem. Achimenes are valuable pot plants, useful for decoration of vases and the verandah. Some varieties are excellently suited for growing in hanging baskets. Hardier kinds may be planted on rockeries. Only the purple flowered forms thrive best in the plains; all others do well from medium to high elevations only.

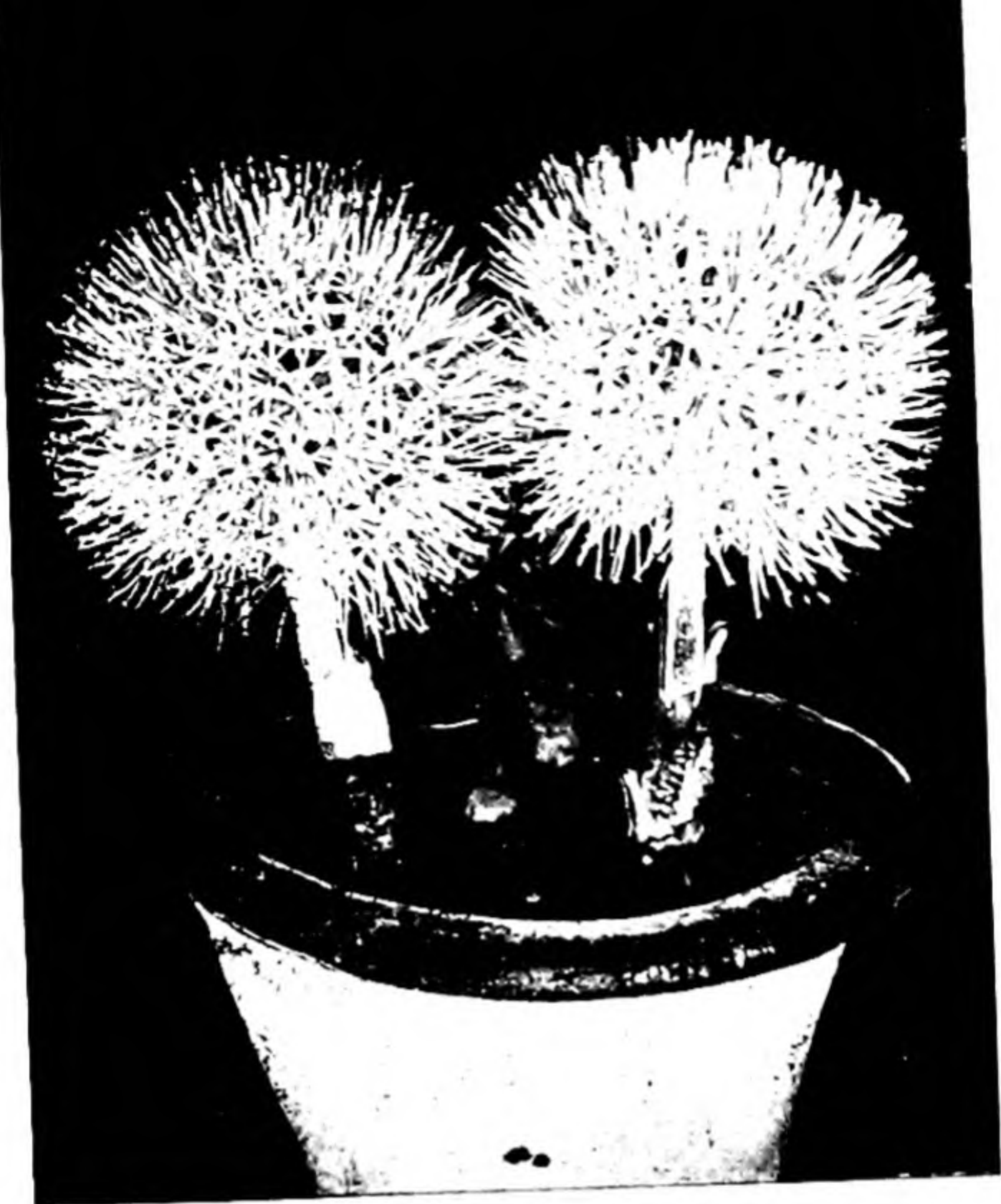
Grow Achimenes in 25 cms. pots, putting about a dozen tubers in a pot. Fill up the pot to about $2\frac{1}{2}$ cms. from the top and have a thin layer of fine sand in it. Space the tubers about 5 cms. apart on the sand and cover up with fine soil, about $1\frac{1}{4}$ cms. deep. Water every other day; keep the pots in shade. Growths emerge out of the soil. Then on, water by the edge of the pots only and not directly on the foliage. With increasing growth of the plants, water them every day. Shelter the plants from strong sun and wind and rain. When the shoots are about 10 cms. high, pinch back their tips for bushing out the plants. Give weak liquid manure (cow-dung water) once a fortnight when they are vigorously growing. Treated this way, blooms are produced in about $3\frac{1}{2}$ months. When the blooms are over, reduce the water supply and finally stop it after the plants

die down. Store the pots with the tubers in them in a cool dry place or take out the tubers carefully and store them in sand. The time for potting in Bangalore is from the end of April to the middle of May and in Madras September to October.

Achimenes are propagated mainly by tubers, which are preserved year after year and increase in quantity every year. Terminal soft cuttings about 4 cms. long, put down early in the season root quickly, grow and die down after forming small tubers. The pots containing them are kept by till the growing season. Propagation from seeds is done for securing new varieties. Seeds are very very small and need to be sown very carefully.

***Agapanthus.** (*Liliaceae*): (The Blue African Lily): A native of the Cape of Good Hope region. One of the most beautiful bulbous plants, not only handsome in foliage consisting of evergreen gracefully arching narrow, thick numerous leaves which are $\frac{1}{2}$ metre long, but also very ornamental when a clump of them is surmounted by abundance of strong clusters of bloom produced on stout scapes, $\frac{1}{2}$ - $\frac{3}{4}$ metre tall. The flowers are blue, funnel-shaped 4-5 cms. long, 10-30 of them being found on an inflorescence, which is an umbel. The white flowered variety is less common. Agapanthus is effectively grown in tubs placed at corners of lawns or entrances to porches. It is a stout rooting plant and hence requires light rich soil and plenty of pot room. Best suited for places 900 to 1800 metres above the sea. Grows in semi-shade. Foliage is evergreen unlike other bulbs. Water liberally during growing season. Apply liquid manures while growing, once a fortnight. Flowers are usually produced during March-April. Repot once in three years but top dress every year. Propagate by separating offsets.

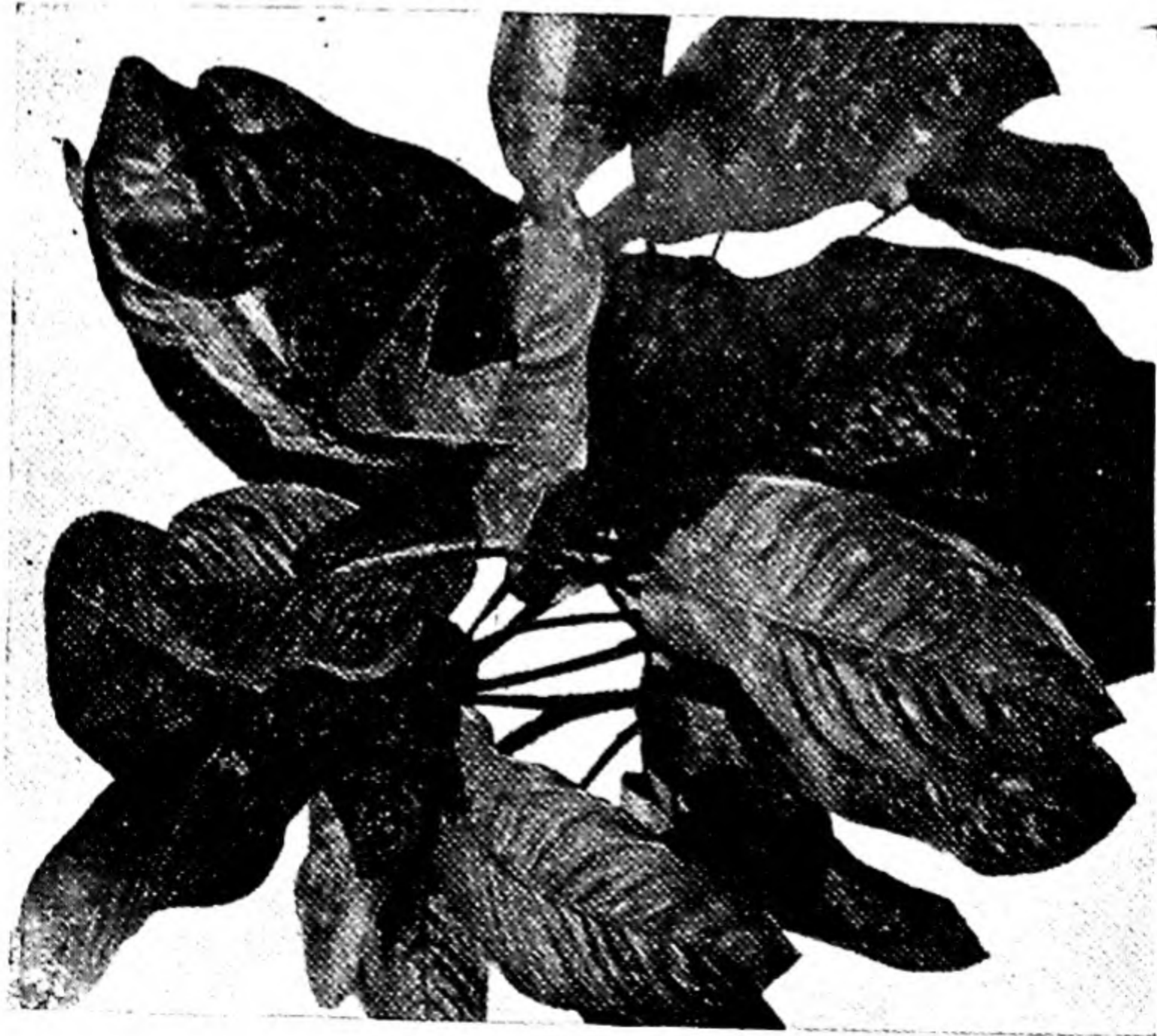
Allium. (*Liliaceae*): Some sub-tropical species of the Onion family bearing attractive flowers may be grown from medium to high elevations. The bulbs are put down 7-5 cms. deep and 10-15 cms. apart in light sandy loam. Some of the best sorts are:—*A. molyluteum* (yellow flowers); *A. neapolitanum* (white); *A. roseum* (pink); All grown like Onions.



HAEMANTHUS LINDENI



ACHIMENES



DIEFFENBACHIA REGINA



GAILLARIDA LORENZIANA DOUBLE

Alstromeria. (*Amaryllideae*): Peruvian Lily. Grows $\frac{1}{4}$ – $\frac{1}{2}$ metre. Flowers are large, ornamental, spotted and streaked on petals which are twisted. Plant bulbs 10 cms. below the soil and 30 cms. apart. Remove fading flowers to prevent seeding and weakening of the bulbs. Suited only for medium to high elevations. Some good varieties are :— *A. aurea* (golden-yellow flowers); *A. revoluta* (deep orange, spotted carmine); *A. haemantha rosea* (pink).

***Amaryllis.** (*Amaryllideae*). (*Hippeastrum*): A family comprising of some of the grandest flowering plants. Natives of the Cape Region and South America. The garden 'Amaryllis' are hybrids of *Hippeastrum*, being evolved from the South African species, *H. vittatum*, *H. Reginae*, *H. pardianum* and *H. Leopoldii*, by crossing and intercrossing. Two to four large trumpet-shaped flowers, are borne on stout erect scapes, $\frac{1}{4}$ – $\frac{1}{2}$ metre tall, well in advance of the foliage. Flowers are pure white to bright crimson, blended in a great variety of streaks and bands. They are invaluable for cutting. Cut the flower-stems near the base just after the buds open and keep in water indoors. Remove a slice of the stalk at the bottom and change the water every day. Looked after in this manner, flowers remain fresh for about ten days.

Amaryllis are effective in borders when in bloom and are often used for edging walks and paths. They also make easily grown pot plants. Once planted in the border or in prepared beds, they need no further attention, thriving and increasing in size and producing offsets in the rainy season, going down about November and coming up again with their beautiful flowers just after summer showers in March or April. For pot culture, take out bulbs from the ground or their pots and keep them in a cool dry place for about a fortnight, in December or January, in Bangalore. Then, pot them one each in a 15 cms. pot or three in a 30 cms. pot in such a way their crowns are exposed. If the old pots the bulbs are in are not full of roots, it may be needless to repot, in which case top dress the soil with fresh compost. Soon after potting, water liberally and keep the pots in a shady situation. Sprinkle or sparingly water till flower spikes

appear. Then on, regularly water every day and apply weak liquid manure of cow-dung or horse-dung once a week. Flowers appear in February-April. Cut back the flower stalks after blooms fade. After the period of growth, leaves begin to turn yellow; then decrease the supply of water gradually. When all the leaves are gone, withhold water from the plants. Then store the bulbs. Propagate from offsets, or from seeds, from which blooms are obtained after 3 years.

A. belladonna is the Belladonna Lily. It has strap-shaped leaves and bears normally Lily-like rose-red fragrant flowers on scapes, $\frac{1}{2}$ to 1 metre long. Flowers freely on the hills. Plant 10-15 cms. deep and 30 cms. apart.

A. vittata bears flowers, orange with white throat, on scapes about 30 cms. high. Flowers in February-March in great profusion. Very pretty in borders as floral edging.

A. reticulatum and *A. Mrs. Garfield* have broad white band on the midrib and bear pink flowers. They are both fernhouse-plants.

A. stylosum, called Storm Lily. Makes a good show in the border or in lawn in clumps, bearing pink flowers early in the hot months.

A. formosissima. See under Sprekelia.

Anemone. (*Ranunculaceae*). (Wind-flower): Perennials of small growth, bearing pretty single or double flowers resembling Poppies or Chrysanthemums, there being two types of flowers. Hybrids of *A. coronaria*, especially, the St. Brigid strain, are usually grown. They are propagated by imported tubers or from seeds. They thrive only on hill stations but at medium elevations they may be grown for one or two years with some amount of success. Tubers should be potted 2-4 cms. deep in light soil, placing three of them in a 25 cms. pot, with a layer of sand all round them. Weak liquid manure may be given when plants are growing. Treated properly, they flower in February-April, planted in October, at medium elevations. On the hills, tubers are started in March to bloom in July-August. Properly grown, they flower in 6 months from seed. The flowers of the first season are not large. But the bulblets, if preserved safely, and started next season, produce first class results.

Arisaema. (*Aroideae*). (Snake Lily): Hardy tuberous-rooted curious looking plants $\frac{1}{2}$ – $\frac{3}{4}$ metre high, most of the varieties having strangely mottled thick flower-stems. Plants should be freely watered during growth and kept dry afterwards. *A. speciosa* (Snake Lily) is very ornamental, the greenish purple spathe broadening out and folding over the spadix like the hood of a cobra. *A. fimbriata* has beautifully fringed spadix.

Begonia. Tuberous rooted Begonia has been dealt with in pages 425–426.

Belamcanda *chinensis* = *Pardanthus chinensis*. (*Iridaceae*). (Leopard Flower or Black-berry Lily): A bulbous plant. $\frac{1}{2}$ – $\frac{3}{4}$ metre tall, with Iris-like decorative foliage, and thriving in light rich soil in well drained sunny borders, bearing flowers, nearly 5 cms. across and of orange colour, spotted red. The bulbs are placed 8 cms. deep and 8 cms. apart and watered moderately. Propagated by offsets or from seeds, which are shining black and rounded.

Calla. (*Aroideae*). (Arum Lily): Callas come under Richardias. They are popularly known as Arum Lilies.

Richardia aethiopica (*Syn R. africana*) (the Arum Lily) is a moisture-loving tuberous plant with handsome foliage of dark green, large arrow-headed radical leaves bearing showy blooms composed of a large pure white spathe enclosing the spadix bearing minute flowers. The blooms are used in Easter decorations. Rich light soil, good drainage, plenty of moisture while growing and shady situation are necessary for success. The plant dies down in the cold season and comes up again in March. Confine the roots in small 15 cms. pots or put three bulbs in a 25 cms. pot or there will be rank foliage at the expense of flowers. On hill stations, near running water, Callas do excellently well blooming freely; but in the plains they seldom flower. Propagated by offsets.

R. Elliottiana is the yellow Calla, which is less common than the white variety. Leaves are spotted white and decorative.

R. maculata has pleasing, green foliage, marked with crystal white spots. Flowers are pure white.

* **Canna.** (*Scitamineae*): Popular ornamental rhizomatous-rooted plants, $\frac{1}{2}$ – $1\frac{1}{2}$ metres high, with handsome strong

musa-like foliage of green, or bronzy green or bronze colour, bearing erect large bunches of bright colours. The garden Cannas are derived from *Canna indica* (called the Indian Shot on account of the seeds which are hard, round and black, resembling shots), which is a native of the Indian wilds bearing small but comparatively insignificant yellow or scarlet flowers. The modern cannas are really plants of imposing beauty, stately in appearance and gorgeous in bloom. For massing in large beds and for cultivation in pots alike, they are invaluable. There are several types of Cannas, the most favoured now are those bearing large trusses of flowers of large size. There are kinds which grow very tall, $1\frac{1}{2}$ metres or more, others are of intermediate height, and some are dwarf kinds flowering within $\frac{1}{2}$ metre.

Cannas thrive in open sunny situations in heavily manured soil cultivated about 60 cms. deep. Except during the hottest months, they may be planted at any time of the year. Just before the rains would be the best time for planting. Take up the old clumps and clean the roots. Cut away unhealthy parts. Cut up fresh portions into clean bits, 15–30 cms. long, each bit having at least one bud. Plant them $\frac{1}{4}$ – $\frac{1}{2}$ metre apart and 8–10 cms. deep. Flood the bed with water once in three days till shoots come up the soil. Increase the supply of water as growth progresses. When the plants are growing well, never water the surface of the soil only. Soak the soil through. In 3–3½ months, blooms are produced on vigorous shoots. Cut back the stalks which have flowered to ground level. Feed the plants with liquid manure prepared from oil-cake once every fortnight. Dig up the beds once a year and replant them. Canna roots in open ground cannot survive a severe summer in hot places unless some care is taken of them. They are best taken up early in April and preserved in shade and watered twice a week till they are planted or potted in August.

Pot cultivation of Cannas is very simple. Put 5 or 6 bits of roots into a large 45 cms. pot using Compost No. 1 mentioned on page 126. Grow as indicated above for ground plants.

Propagation is ordinarily done by division of rhizomes,

which grow and multiply under the ground. See figure 47. New varieties can be grown from seeds, selected from large flowering kinds after cross pollination. As the seeds are very hard, they have to be filed in one place and soaked in water at least for two days before sowing.

The following are some few out of numerous select varieties of Cannas. Those with bronze foliage are marked (b):—

Alize (b), crimson; Apricot, apricot-pink; Black knight (b), deep velvety red; Burpee's Pride, beautiful orange with copper shade. Buttercup, pale yellow; Carmine King, carmine, mottled yellow; Copper Giant, madder-orange shaded copper; Coquette, apricot-pink dwarf; Dr. Erwin Ackernecht (b), bright crimson rose; Emperor William, dark crimson, dwarf; Empress of India (b), deep cherry-red; Enchantress (b) apricot and yellow; Eureka, nearest approach to white; Feu'r Zanber (b), more brilliant than Empress of India; Flame, bright salmon-pink; Frau Dr. Klien, rich rosy-red, with deeper coloured dots and mottles; Garten-schonheit, deep rose with dots of deeper colour; Golden Wedding, rich golden yellow, dwarf; Herbert Hoover, deep rose, huge trusses; Herman H. Hesse, deep red; John Lochner, pink; John Tulette, rich yellow, very pretty small flowers in compact trusses; Liberty, rich chromy orange; Minehaha (b), bright pink, dwarf; Mrs. Woodrow Wilson, orange-pink; Niagara, deep crimson, dwarf; Percy Lancaster, yellow, spotted deep red; Princess (b), brilliant pink; President, brilliant poppy-red; Queen Mary, rosy pink with salmon, shading off to cream at edges; Radio, huge creamy white trusses, flowers very faintly and sparsely dotted lilac; Sir John Anderson, deep vivid orange; Stadt Fellback, golden orange with streaks of deeper colour; Statue of Liberty (b), huge trusses of flaming red, very handsome shining bronze foliage; Yellow King Humbert, yellow, splashed and blotched crimson-red.

There are many more recent hybrids evolved and introduced by Mr. Percy S. Lancaster in very attractive colours.

Clivia. (*Amaryllideae*): South African Amaryllids, better known as Imantophyllums, with handsome evergreen foliage

of deep green strap-shaped leaves and showy tubular red and yellow flowers in large umbels. The bulbs are imperfect and are formed mostly of old leaf-bases. As in *Agapanthus*, the root system is thick and fleshy. Pot three bulbs, of the size of *Amaryllis*, in a 25 cms. pot, in December and February at medium elevations and high elevations, respectively. Established plants may be grown in the same pots year after year with annual top dressing. Apply weak cow-dung water during growing season. Sparingly water during winter. Repotting, if any, is best done after flowering. Propagate by division of clumps. From seeds, it takes 3-4 years for blooming.

Clivia miniata (Coffre Lily) bears funnel-shaped flowers of a bright scarlet colour with a yellow throat, 12-20 of them being clustered together in an umbel. *Imantophyllum chrysantheflorum* bears salmon-red flowers. *I. nobilis* is another pretty species.

Crinum. (*Amaryllideae*): Extensive genus of plants, allied to *Amaryllis* and bearing flowers, which are white or red tinted, mostly in summer. Many species are natives of this country. The stem rises from a bulb with a more or less elongated neck; the foliage is handsome consisting of long, strap-shaped leaves; the flowers too are very handsome, large, mostly sweet-scented, and borne on top of tall, fleshy stout scapes. *Crinums* may be generally divided into two types:—(a) Those, which have more or less evergreen leaves and Leek-like elongated bulbs and bear symmetrical, star-like, straight-tubed, more or less erect flowers; and (b) those which are deciduous and bear mostly roundish bulbs and produce nodding irregular bell-shaped flowers. All of them are propagated by offsets. Rarely, they are raised from seed. Most species are hardy and need no particular attention after planting. They do well in the ground forming large clumps with offsets. Large pots or tubs are necessary for growing them. Sunny situation, rich friable soil, and plenty of water during the growing season are essential. At times, leaves and flower-buds are attacked by black caterpillars. The following are a few noteworthy species:—

* *C. asiaticum* has columnar stem-like bulbs, which are 25 to 40 cms. long and should not be planted deeper than

7.5 cms. Leaves are strap-shaped, $\frac{1}{2}$ – $\frac{3}{4}$ metre long. Flowers are produced almost all the year round; the scapes bear as many as 20 large deliciously fragrant pure white flowers. *C. asiaticum variegatum* has variegated foliage, bands of white on green, best developing colour when pot bound or when starved.

C. longiflorum is a common scented variety with scapes carrying 8–12 large white bell-shaped flowers.

* *C. Moorei* has large bulbs, 12–20 cms. in diameter, with slender stem-like neck, about 30 cms. long. Leaves are thin, wavy, long and very beautiful. Flowers are fragrant, bell-shaped, blush-pink, and borne 4–10 in an umbel on the scape. A truly noble species. There is also a white variety of the above.

* *C. Powellii* is another handsome species, with long graceful spreading leaves and large showy heads of rose coloured flowers. *C. Powellii variety album* bears white flowers. *C. Powellii variety inter-medium* bears light rose coloured flowers.

Other handsome species are *C. americanum*; *C. giganteum*; *C. Sanderianum*; *C. amabilis*; *C. Kirkii* and *C. zeylanicum*.

Cooperanthes. (*Amaryllidaceae*): Plants very much like and derived from *Zephyranthes* bearing flowers in a wide range of colours in white, pink, rose, orange, and yellow shades. Unlike the Wind Flowers (*Zephyranthes*) which flower only when the monsoon starts, *Cooperanthes* produce sheaves of bloom springing up suddenly within two days of a shower of rain. Grown like *Zephyranthes*.

Costus. (*Zingiberaceae*): Rhizomatous-rooted plants of dwarf or semi-dwarf habit, with attractive foliage and leafy stems, bearing flowers in spikes with overhanging bracts. They are natives of India and thrive in a compost of sandy loam to which a little peat is added. They are effective as pot plants and on rockeries in semi-shady situations. Propagated by division of rhizomes. *C. igneus* bears bright orange-yellow flowers and is furnished with handsome foliage; height of plant, 40 cms. *C. speciosus* is an elegant species woody at base growing about 1 metre high, with oval leaves spirally

arranged on the leafy stem and bearing at its apex a spike of white flowers, about 10 cms. long. This species does well with orange red centre 500 metres above the sea, in partial shade. *C. elegans*; *C. pictus* are other attractive species. *C. malortieanus* stout nearly 1 metre, attractive large leaves 35 cms. long, green with deeper zones, flowers yellow.

* **Cyclamen.** (*Primulaceae*): Tuberous charming plants, with neat and dwarf habit of growth, with beautiful foliage of radical long-stalked leaves, bearing stalked flowers of purple, rose or white colours. Bulbs are circular and compressed rootstocks, from which leaves and flowers spring. There are several species, of which *C. persicum* (Persian cyclamen) is the most popular. *C. africanum*; *C. ibericum* and *C. neapolitanum* are also handsome species. Several improved varieties have been raised by cross-pollinations and careful selection.

Although Cyclamen is a perennial and is capable of flowering year after year from the same bulb, it is best raised from seeds every year. Thrives only from medium to high elevations. Sow seeds in well drained seed pans in soil composed of equal parts of loam, sand and sifted leaf-mould. Fill up the soil to within 1 cm. from the top of the seed-pan; press the soil lightly down and level it; space out the seeds 2 cms. apart and cover with $\frac{1}{2}$ cm. of fine soil. Water with a fine-rosed water can and cover the pan with a plate of glass to keep the soil moist. Keep the soil just moist, without allowing it to get dry, by occasional supplies of water, when necessary. Keep the pan in a shady situation. Germination is slow and irregular. Small bulbs appear from which tiny leaves emerge in a month or so after sowing. As germination becomes complete and as more and more leaves are formed in succession, allow morning sun to seedlings and remove the glass plate from the top of the pan. Water them with care as too much rots the young bulbs and too little injures them beyond recovery. When leaves of adjacent bulbs are touching each other, lift each little plant carefully and pot it in a 7 cms. pot, using similar compost. Let the crown of the bulb be on a level with the top of the soil; rot sets in if the crown is buried under the soil. Give the plants only morning sun. Shift them to 15 cms. pots, using Compotst No. 3 on

page 126. As plants grow, feed with weak liquid manure prepared from cow-dung, once a fortnight, especially just before flowering. Keep the foliage clean by syringing with clear water. If plants fill the 15 cms. pots and can grow more, shift them to 20 cms. pots. Blooms may be expected in 8-10 months after sowing. Grown well, the bulbs attain a size of 2-4 cms. in diameter and bear 12 or more flowers; as many as 30 to 40 flowers are reported to be borne on a single plant at a time on hill stations. Exercise great care in watering at every stage of growth and especially during the blooming period; over watering surely brings on rot to the bulbs. When the blooms are over and the foliage begins to show discolouration decrease the supply of water. After the foliage dies down completely, withhold water from the bulbs; take them out of the soil; put them in a cool dry place in sand till potting time in October or November at medium elevations. On the hills, they are started in March to flower in July-August.

Cyrtanthus. (*Amaryllideae*): South African plants, about 30 cms. high, with globose bulbs and attractive drooping tubular flowers in a wide range of colours including white, cream, pink, yellow, red, scarlet and apricot, about seven on a scape. Suited for medium to high elevations. Useful for edging and rockeries. Propagated by offsets.

Daffodil = Narcissus. (*Amaryllidaceae*): These well known Spring-flowering bulbs do not flower in the plains and at medium elevations. The only kind which flowers at medium elevations is the early Jonquil, which bears only small flowers. On the hill stations, the bulbs are put down in February, 1-3 in a pot, according to the size of the bulbs. The bulbs may also be planted out as soon as signs of growth are noticed in them, about 5 cms. deep and 12 cms. apart. There are three types of Daffodils, the early flowering, the medium flowering, and the late flowering.

***Dahlia.** (*Compositae*): One of the most gorgeously coloured, free blooming, easily cultivated popular plants. They are not tuberous-rooted, in the sense that potatoes are. They are provided with fleshy roots, in which nourishment for the production of annual stems and flowers are stored and

these roots are connected to a crown bearing a number of eyes or buds. Flowers are useful for cutting, are single or double and brilliantly coloured, being available in a wide range of colours ; the only colour not available is the blue. For mass effect in borders, for cultivation in large beds and for pot culture, there are few plants to excel the Dahlia. Flowers are of several forms and sizes. The following are well recognised types of Dahlia :—

- (1) *Show or Double Dahlias.*
- (2) *Fancy Dahlias.*
- (3) *Pompon Dahlias.*
- (4) *Double Decorative Dahlias.*
- (5) *Double Cactus Dahlias.*
- (6) *Collarette Dahlias.*
- (7) *Paeony flowered or Art Dahlias.*
- (8) *Single Dahlias of different kinds.* The Century, Single Cactus, and Star Dahlias are attractive single flowered kinds.

(9) *Pigmy or Tom Thumb Dahlias.* The latter grow only 30-45 cms. high and are useful for bedding out.

Propagation is by one of the three following methods :—

(a) By cuttings, which is more or less the commercial method. Propagation by cuttings, is a cheap way of making a collection. Slips with the heel attached are more successful than terminal cuttings. Terminal cuttings should be tender and should possess no hollow at the core at the place cut. The cuttings are inserted in pure sand and are taken care of like cuttings of other kinds of plants. They strike root and develop small bulbs, which go to rest after the growing period. They grow bigger and bear larger flowers during the next growing season. (b) By division of the 'tubers'. Time for planting is generally indicated by swelling of the buds on the crown to which the tubers are attached. The roots are kept on moist sand and sprinkled with water. When buds have grown about 1 cm. the clumps are divided in such a way that each part has a growing bud on it. (c) By seed. Seeds are sown 5 cms. apart in seed-pans or nursery beds and the seedlings potted off or planted out when they are about 5 cms. high. Seeds collected from large double flowers give a large percentage

of double flowering plants. The blooms improve as the fleshy roots develop after the first year.

Dahlias can be grown throughout India, except at the hottest places. A moderate rainfall during its growing and flowering period and a mild climate with comparatively humid atmosphere are conducive to best results. At Bangalore, planting is done about the end of May or early in June for blooms early in August. At Madras, it is done in October or November for blooms in January and February. On the Nilgiris (Ooty), bulbs are planted in March and April. At Hyderabad (Deccan), planting is done in June or July. Seeds may be sown about the same time as planting of bulbs or a little earlier. Good blooms are not produced if seeds are sown late in the season. At high elevations, plants are liable to be killed by frost.

Dahlias are cultivated in pots in the following manner:— Start the tubers by placing them in a cool place in moist sand for four or five days. Cut them up into pieces as indicated above. Place each tuber in a pot. Choose a large pot, a 35 cms. pot. Fill it to a little more than half with Compost No. 3 on page 126. Place the tuber with a handful or two of sand under it and cover it about $2\frac{1}{2}$ cms. deep with the compost. Water plentifully soon after planting and then sparingly till shoots emerge out of the soil. Keep the pots in an open sunny situation, well sheltered from wind. Remove all but the strongest shoot. As it grows, fill up the pot to about 1.25 cms. from the top with the soil covering the new shoot at the base. When it is about 20 cms. high, cut its growing tip to induce branching. Retain only three of the shoots that come up. Stake the plants as they reach 22-30 cms. Water liberally as growth progresses and do not allow the plants to flag for want of water. It may be necessary to water them twice a day on warm sunny days. Feed with liquid manure, prepared out of oil-cake once in ten days, from the time the buds are forming. One tablespoonful of mixture of superphosphate and ammonium sulphate in the proportion of two of the former to one of the latter, dissolved in water, may be supplied at intervals of applications of oil-cake water. Blooms may be expected, in 40-45

days after the shoots are topped. For exhibition blooms, all except crown buds should be removed. Generally, buds come up in threes. Rub off side buds retaining middle ones. For garden decoration, it is desirable to have a large number of flowers on the plants; in which case, do not disbud. The blooming period lasts for $1\frac{1}{2}$ –2 months. After flowers are over, diminish the supply of water gradually till all the leaves and shoots die down. Then cut back the dried stems to the ground level; free the roots from the soil and store them as suggested in page 494.

Dahlias are grown in the ground in much the same way as in pots. The ground should be well worked—at least 60 cms. deep. They may be planted $\frac{1}{2}$ metre apart. Dahlias grow in any kind of soil, provided the drainage is perfect. But, sandy loam enriched with manure gives best results; open sunny situation, shelter from high winds, freedom from the roots of large trees and shrubs, and plenty of water are essentials for good results.

Dahlias are comparatively free from insect and fungus pests. Green flies or aphids are very common; before they weaken the shoots, spray with weak tobacco or soft soap solution. Sometimes, mealy bugs attack the roots and stems. They must be rubbed off and affected parts sponged with methylated spirits. Slugs attacking Dahlias may be caught at nights or kept away by sprinkling soot or lime on the surface of the soil. Beetles, sometimes attack them and they are handpicked and destroyed. In certain localities, on account of bad culture and unfavourable environment, mildew sets in, when spraying with Bordeaux Mixture is helpful. If the attack is severe, plants should be cut down and new growth started with suitable precautions.

* **Eucharis.** (*Amaryllideae*): A very handsome bulbous plant with large radical dark shining leaves, 45 cms. in length, bearing late in winter and at other times with suitable treatment, pure white, sweetly scented, lovely saucer-shaped flowers, 5–7 of them being carried well above the foliage on long stout scapes. Eucharis are highly capricious in point of flowering, only a few out of many bulbs flowering. The bulbs are 2–5 cms. in diameter. They thrive

well in soil, inclined to be heavy. *Eucharis* does not like frequent repotting. Protection from full sun-shine, good drainage, and a north-east aspect conduce to best results. Liberal supply of water, frequent syringing of the foliage keeping it clean, and applications of liquid manure (dung-water) when the flower-scapes show are also necessary. The only pest is the black caterpillar, which is handpicked and destroyed. There are several species; *E. grandiflora* is the one most commonly grown.

* **Eurycles.** (*Amaryllideae*): Free flowering tunicated bulbous plants with large round leaves, bearing creamy white flowers resembling those of *Eucharis* on erect peduncles, 30-45 cms. long. Flowers are pretty and nearly 5 cms. across. Grown like *Eucharis*. *E. sylvestris* = *E. amboinensis*, which is known as the *Brisbane Lily* is the largely cultivated species.

Freesia. (*Iridaceae*): Genus of dwarf bulbous plants producing bell-shaped deliciously fragrant flowers, six to eight of them, in clusters, being borne on slender stalks above the foliage. Flowers are useful for cutting and are now available in rose, blue, yellow, bronze, red and bi-colours. *F. aurea* bears yellow flowers. *Freesia refracta alba* is very pretty with its white flowers. Bulbs are small and cormous in nature. Put 5-7 of the largest sized bulbs into a 20 cms. pot using Compost No. 3 on page 126. Cover up with soil and press the soil down firmly. Water sparingly at first and increase the supply as growth progresses. Give weak liquid manure, prepared from cow-dung, once in fifteen days, as plants develop. Only bulbs which have been fed and well cared for during their period of growth produce flowers satisfactorily. Decrease the supply of water as the foliage turns yellowish and stop watering after it has died down completely. Keep the pots dry for a month or so with the bulbs in them and then remove bulbs for storing. Grow the small immature bulbs separately to develop and produce flowers next year. Freesias flower from seed the third year after sowing. They thrive only from medium to high elevations.

* **Gesnera.** (*Gesneraceae*): Tuberous-rooted plants, allied to *Achimenes* and treated like them. Flowers are showy,

tubular and droop from the branching erect stems. Only some species thrive in the plains, if kept shaded from sun and grown in cool plant houses, well drained light soil, shelter from sun and rain, and careful watering are necessary. Propagated by tubers and from seed also. Species with succulent leaves may be increased by leaf-cuttings. *G. splendens* grows 30-45 cms; bears bright red showy flowers. *G. refulgens* is another attractive species. Many hybrids of recent origin are very handsome.

* **Gladiolus.** (*Iridaceae*): Gladiolus takes its name from the Latin "gladius", a sword, which was given to this plant on account of the sword-like shape of its foliage. Very popular decorative plants with grassy one-sided stems and long spikes of flowers, which are available in rich varied colours of almost every shade. The spikes are excellent for cutting for the vase, coming to full development when kept in water, till the last flower opens.

The early classification into types as Childsii, Lemoinei, primulinus, Nanceanus, Gandavensis, and Brenchleyensis is no longer of any use now, as the best kinds are now the results of intercrossings of almost all types.

Grow them in deep rich sandy loam in sunny situation sheltered from wind. Use Compost No. 3 on page 126 for pot culture. Plant the corms 5-7 cms. deep. Water sparingly at first, and more freely as growth progresses. Shoots with sword-like leaves arranged in one plane come up soon, one on each corm. If the plants are not staked from the time they are 15 cms. high, the flower stems and spikes grow crookedly. Apply liquid manure once a week. Top dress the soil when the plant has made about 15 cms. of growth. After flowers are over, leaves begin to turn yellow; reduce the supply of water gradually till the leaves dry up, then withhold water from the plants. Never allow the flowers to go to seed, as the corms would be robbed of their vitality. Cut away the stalks of flowers after they fade. Three to five weeks after flowering, lift the corms, tie up in a cool droughty place in order to dry off the moisture from the stems. When dry, clean the bulbs and store them in paper bags or in dry sand in a dry airy place. Gladiolii are

usually planted in the month of June to flower in August at Bangalore. At low elevations, the imported corms should be started in September-October. Best results are only obtained at medium to high elevations. It is necessary to start the corms by keeping them in moist sand and plant them out after shoots are formed.

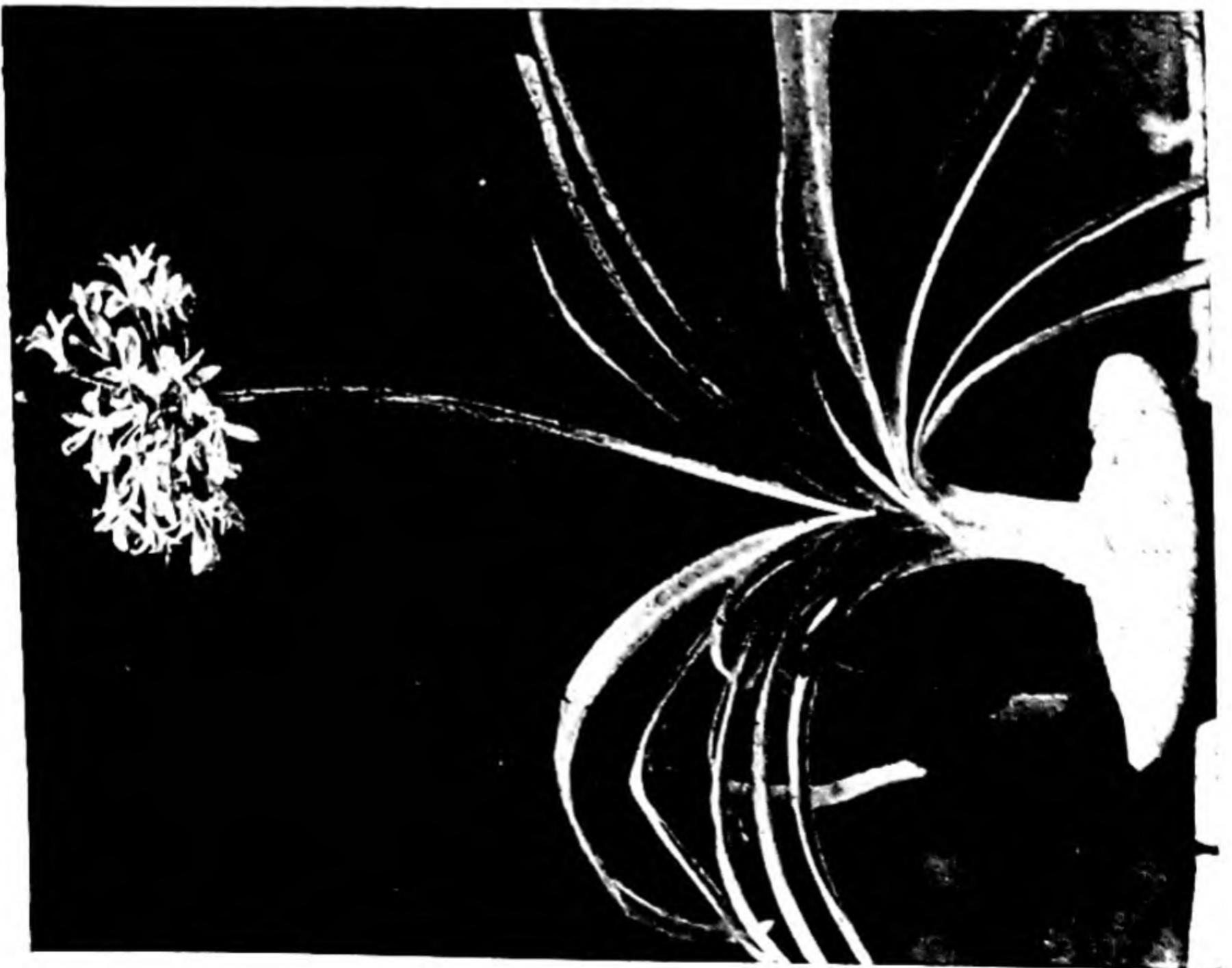
Propagation is from seed or by offsets called spawns. From seeds, new varieties are obtained. Sow seeds in well drained seed pans in light porous soil. Thin out seedlings if too crowded, harden them, and allow them to remain in the same pans for two seasons for the corms to develop. Water less and less when the leaves begin to turn yellow till they dry up when watering should be stopped. At the end of the second year, bulbs are large enough to be potted. Put 4 or 5 of them in 12 cms. pots. But, flowers are produced only after three years of sowing. The more rapid and easy method of propagation is by separating the bulbils or spawns from the old corms and sowing them in nursery beds, 5 cms. apart. They mature in one to two years and bear flowers.

Gloriosa (*Liliaceae*): (Canarese: "Karadikannina gedde"; Hindi: "Cariari") *Gloriosa superba*. The Climbing Lily, the best known species, is a tall, weak-stemmed, slender deciduous tuberousrooted indigenous creeping plant, supporting itself by means of tendril-like prolongations of the leaves. Flowers at the ends of stems during the rainy season in great profusion; they are peculiar, with long twisted or wavy crisped petals, reflexed after the manner of Cyclamens, which are light yellow in one half and crimson in the other half, the entire flowers turning crimson as they become old. The foliage dies down with the approach of the cold season and the plants remain dormant till the next rainy season. *Gloriosa* can be grown in pots or in the ground and it is propagated by seeds or division of the Turmeric-like rhizomes. They are planted just before the rains, one rhizome being put into a 20 cms. pot. Good drainage and light rich soil and plenty of water during growth are necessary. The pot should be furnished with a balloon over which the plant creeps and blooms. The root is poisonous.

* **Gloxinia.** (*Gesneraceae*): Florist's Gloxinias or *Gloxinia* hybrids are derived from *Sinningia speciosa* and are strictly *Sinningias*. They are dwarf plants, with very short stems and large hairy leaves producing very showy bell-like flowers on a long stalk. Flowers are available in exquisite shades of colour and are often variously blotched and speckled with different colours. *Gloxinia* hybrids are grown in pots. They are warm-temperate plants, suited for elevations of 750 to 1250 metres. In hot places at low elevations, they are shortlived, the tubers not surviving after flowering once. But, they may be preserved to flower year after year at medium to high elevations. In Bangalore, tubers are started in May to flower in August. In the plains, they are started in November or December. Import one year old bulbs and pot them singly in 10 cms. pots using a soil composed of equal parts of leaf-mould and sand. Cover the bulbs with soil leaving the eyes just exposed. Shift them into 20 cms. pots after the small pots are filled with roots. Do not over-water them. Do not wet the foliage. Ensure perfect drainage. Maintain a warm moist atmosphere and avoid droughts and sudden chills. Shade from direct sunshine. Use Compost No. 3 on page 126 for final potting.

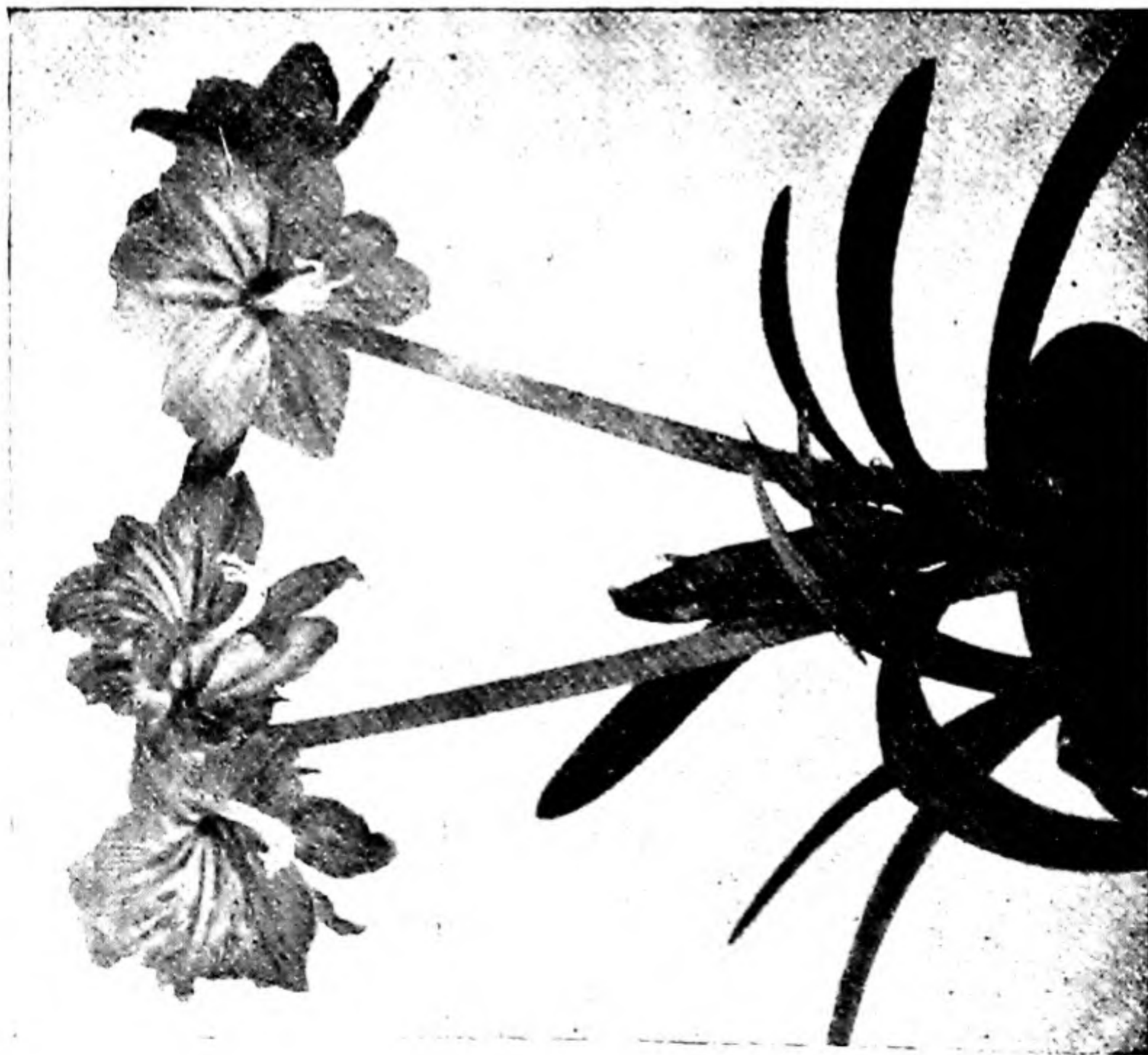
Gloxinias may be propagated from seed, by cuttings of leaves and stem. Seeds are best sown in September-November in the plains and March to May on the hills. Sow in shallow well drained pans in soil composed of equal parts of sifted leaf-mould and sand. Water and cover with a plate of glass. Germination is complete in about a week and in about a month the young seedlings are fit to be potted singly in 7 cms. pots in soil composed of 2 parts of leaf-mould, 2 parts of sand and $\frac{1}{2}$ part of loam. Seedlings damp off if over-watered. Treat the plants as described above. Do not water the small bulbs when they are resting. Start them after the period of rest in the same pots and they will flower during the second year.

Gloxinia maculata is a hardy vigorous growing plant, about 30 cms. high, having pretty bright glossy succulent bronzy green leaves, producing in October and November large blue bell-formed flowers. This species grows with





GLADIOLUS



THE GARDEN AMARYLLIS

comparatively less care than the hybrids mentioned above. In partial shade, in light rich soil, *G. maculata* does well, if supplied freely with water during period of vigorous growth. The resting season is usually from December to May, when the scaly tubers, resembling a mass of caterpillars, should be stored in sand in a dry cool place. Plant the tubers like *Achimenes*, putting one or two in a 22 cms. pot.

* **Haemanthus.** (*Amaryllideae*): (Blood Flower; Blood Lily). Also known as the Red Cape Tulip. Several species are natives of South Africa. All are bulbous plants carrying spherical umbels, pin-cushion like large heads, on a scape. Flowers precede leaves and are of shortlived beauty, looking like scarlet powder-puffs and are produced in March-April. The bulbs may be grown in pots or in the ground. Pot firmly three bulbs in a 22 cms. pot or one in a 12 cms. pot. placing them half their depth in the Compost No. 3 on page 126. Water carefully till plants get into active growth and then freely till the bulbs go to rest. Supply weak liquid manure to strengthen the bulbs. The larger the bulbs, the larger are the heads of flowers. It is not necessary to pot the bulbs every year; they may be continued in the same pots for two or three years. Propagated at potting time, in February in Bangalore, by offsets which are removed from old bulbs and are potted in small pots. *H. multiflorus* bears scarlet-crimson heads of flowers, about 15 cms. in diameter, on short erect scapes, about 30 cms. high, before the leaves appear. *H. Lindeni* is a superior species with larger heads of rosy-scarlet flowers.

Hedychium. (*Scitamineae*): Called differently as Orchid Lily, Butterfly Lily, Ginger Lily and the Garland Flower. Ornamental rhizomatous herbaceous perennial plants growing from 1 to 2 metres and bearing in the rainy season large showy spikes, which are 15-45 cms. long and 10-30 cms. in diameter. Flowers of some species are fragrant. Colours of flowers are white, scarlet or yellow. The plant has stems with sheathing leaves and grows like the Canna. Stems die down in the cold weather as the plants are dormant in winter. They are increased like Cannas by dividing the roots and potting them. A moist semi-shady situation suits

them best. They are too tall to be satisfactorily grown in pots. They do best in swampy conditions, on the side of a drain, where the ground is constantly wet.

H. coronarium (Indian Garland Flower) is a commonly grown species. Stems rise $\frac{3}{4}$ –1½ metres. in succession in the rainy season bearing large terminal spikes of fragrant white flowers with an yellow blotch in the centre. This species is best suited for low elevations and it succeeds best as a semi-aquatic in rich deep soil with abundant supplies of water. *H. coccineum*; *H. elatum* and *H. flavum* are some other handsome species. *H. Gardnerinum* is a favourite species. All these flower freely only at hill stations.

Hemerocallis. (*Liliaceae*): Called the Day Lily. Plants with roots which are bundles of fleshy tubers and leaves which are two-ranked, linear, acute and grassy, bearing single or double large and attractive flowers on erect tall scapes, early in hot weather. Hemerocallis does not bloom as freely at low elevations as at medium elevations. Propagated by division of fleshy roots. *H. aurantiaca* (Golden Lily) bears large orange coloured fragrant flowers. *H. fulva* (Lemon Lily) bears yellow flowers; it does not grow as tall as the preceding species. Recently more than 50 varieties have been introduced by National Botanic Garden, Lucknow.

Hippeastrum. See under Amaryllis.

Hyacinth. (*Liliaceae*): Hyacinths are bulbous plants bearing pretty spikes of flowers. They are grown from imported bulbs. Suited for hill stations. Put the bulbs in pots proportionate to their size, one in a 15 cms. pot or three in a 20 cms. pot and cover up with soil composed of sand, leaf-mould and charcoal only. Water very sparingly till growth starts. Keep in shade in a dark place. Bring them out when flower spikes are 5 cms. high.

Hymenocallis. (*Amaryllidaceae*): "The Spider Lily." Very much allied to *Pancratium*s but more delicate to grow in the plains than the latter. For culture, see *Pancratium*s. They bear masses of delicate white flowers.

Imantophyllum. See under Clivia.

Iris. (*Iridaceae*): There are innumerable species and

varieties in existence but only a few are free blooming and worth cultivating in this country. Iris form a very interesting class of plants remarkable with two-ranked narrow long leaves and curiously constructed flowers of attractive and gorgeous colours. There are two groups of Iris, the rhizomatous-rooted and the tuberous-rooted. Plants evince marked diversity in habit of growth, from 15 cms. to $\frac{3}{4}$ metre. Propagation is from seeds or offsets in the bulbous group and by division of rhizomes in the rhizomatous group.

Iris thrive only at elevations of 1450 to 2250 metres being best suited for sub-tropical and temperate conditions. Those which flower below 1500 metres are *I. germanica* and *I. fimbriata* (Japanese Iris), both requiring shady and moist situations. Rich sandy soil containing a large quantity of leaf-mould and well rotten cattle manure suits them best. The rhizomes or tubers should not be kept out of the ground for any length of time. Planting should not be too deep; it may be in the ground or in pots. *I. germanica*, Flag Irises, have creeping root-stocks (rhizomatous), sword-like leaves, and bear flowers on erect stalks. A hardy and vigorous class which should be kept moist in summer. Propagated by division. *I. Japonica* are fibrous rooted and require plenty of water. Just cover the roots enabling them to hold the soil firmly. Plant 45 cms. apart.

Isoloma. (*Gesneraceae*): Now known as *Tydaea*. Perennial herbs of American origin, allied to but coarser than *Achimenes* and *Gesnera* and needing the same treatment. Suited for pot culture, being compact growing. Flowers are produced in the cold weather between October and November. *Tydaea amabilis* grows $\frac{1}{4}$ – $\frac{1}{2}$ metre high, has velvety leaves and bears showy dark rose coloured solitary flowers with long peduncles from the axils of the upper leaves. Tydaeas require shaded situation and thrive only from medium to high elevations.

Ixia. (*Iridaceae*): Called the African Lily. Pretty bulbous plants from South Africa with grass-like foliage and spikes of flowers, useful for cutting for vase-decoration. They are all hill types and do not thrive at low elevations. Grown in much the same way as *Gladiolus*; between 1250 to

1900 metres altitude, they do well. They make a display planted in the border in clusters of twelve or more bulbs, 5 cms. apart. The bulbs are small and should not be covered more than $2\frac{1}{2}$ cms. deep. They increase rapidly.

Kaempferia. (*Zingiberaceae*): Ornamental dwarf plants, grown for their ornamental foliage and flowers, with ginger-like rhizomatous roots. They are compact in habit with egg or lance-shaped leaves which are green, bordered or flaked with white above and purple beneath. Plants are deciduous, producing flowers usually before the leaves appear, in a crowded manner opening day after day in the morning and fading in the evening. Flowers are delicately scented and are borne close to the ground; hence unless grown in pots, flowers are hidden from view. Propagation is from the roots which are cut up into bits with buds on them after the leaves die down. Put 4 to 6 pieces into a 22 cms. pot. January or February is the flowering season. Feed well with liquid manure during period of growth. Repotting is necessary only once in two years. Several species are favourites in Indian gardens. *K. galanga* (Chandra-mulika), *K. rotunda* (Bhuin-champa), *K. Gilbertii*, *K. Kirkii*, *K. speciosa* and *K. Parishii* are other desirable species.

Kniphofia. (*Liliaceae*): Synonymous with *Tritoma*. Known popularly as Red-Hot-Poker plant or Flame Flower. Handsome plants with abundant radical sword-like leaves bearing immense spikes, closely covered with brilliantly coloured tubular flowers, which are orange, rose, salmon, scarlet, white or pink in the several species. The flowers last for several weeks and are excellent for cutting for indoor decoration. *Kniphofias* are only suited for sub-tropical conditions and do not thrive at low elevations in India. Propagated by division and from seed, blooming the second year from seed.

T. aloides is a striking object while in bloom. Leaves are ensiform-acuminate, $\frac{1}{2}$ – $\frac{3}{4}$ metre long and about $2\frac{1}{2}$ cms. broad. Flowers are coral-red in colour fading to orange-red and are borne densely on spikes, which are about 15 cms. long and 8 cms. thick, on peduncles, as long as the leaves. Thrives on hill stations.

Lachenalia. (*Liliaceae*): Cape Cowslip. Small bulbous plants, 15–22 cms. high. Thrive from medium to high elevations only. Handsome waxy bell-shaped flowers drooping from a spike. The best variety is *L. aurea* with golden yellow flowers. This variety is very good for hanging basket, for planting in border and for pot culture. Bulbs to be planted 5–7 cms. deep and 10 cms. apart. They should be lifted each year after the foliage dies down and preserved till next season for planting.

Lilium. (*Liliaceae*): Genus comprising of many floral beauties. Liliiums, as a class, do well only on the hill stations and tolerably well at medium elevations of 1000 metres and above. Some species may be induced to flower in the plains but bulbs perish after one season. Liliiums require a comparatively cool atmosphere with moisture all the year round. Lilies are divided into three classes for purposes of cultivation :—(1) Stem rooting kinds, which produce a second and distinct root system on the stem above the bulbs. These roots support the plants throughout the growing period, leaving the original roots to concentrate their energies on the bulb. These kinds should be potted or planted about 15 cms. deep in a fairly rich top soil. (2) Non-stem-rooting kinds may be planted to a depth of $2\frac{1}{2}$ times the size of the bulbs. (3) Swamp lilies require a soil that is always moist but not waterlogged. Sandy peat to a depth of 45 cms. would suit them best. Lilies dislike lime in the soil, with very few exceptions. Use of animal manure also is not conducive to good results. What they require is sandy soil containing a large quantity of well decomposed leaf-mould. Drainage should be perfect. Lilies may be grown in the ground in raised beds or in pots. A situation where the plants get only morning sun should be chosen. Till growth commences, watering should be done very carefully. Water is withheld after flowering when the stem shows signs of withering. Frequent disturbance or repotting does irreparable injury. Lilies multiply quickly and they are propagated by division. Bulbs are imported usually from Holland, England or Japan. They die after two or three years at medium elevations. The following are a few noteworthy species :—

* *L. longiflorum* (Easter Lily): Small bulbs with slender stems about 45 cms. long, bearing in February-March pretty fragrant pure white flowers about 15 cms. long. Leaves die down in June and the resting period lasts till September, when they are potted. As bulbs do not survive being kept long out of the ground, great difficulty is experienced in obtaining them in good condition. Stake plants when they are 15 cms. high. Popularly known as Madonna Lily.

* *L. tigrinum* (the Tiger Lily) grows $\frac{1}{2}$ to 1 metre, high, bearing flowers which are deep orange-red, spotted dark purple. Moisture all the year round and coolness are necessary for satisfactory growth.

* *L. giganteum* grows to about 20 metres has heart or egg-shaped leaves, 30-45 cms. long; bears on each stem 5 to 6 flowers, which are 12-15 cms. long and about 10 cms. in expansion. Blooms in August.

* *L. auratum* (Golden-rayed Lily) grows to 1 metre, bearing white or yellow flowers with orange spots.

* *L. candidum* grows $\frac{1}{2}$ to $\frac{3}{4}$ metre bearing white flowers. It is the true Madonna Lily.

L. Neilgherriense grows $\frac{3}{4}$ metre high, bearing large trumpet-shaped flowers, 22 cms. long and 12 cms. in expansion at the mouth.

L. Harrissi (Bermuda Lily) bears large white flowers.

Mirabilis. (*Nyctagineae*): *Mirabilis Jalapa* is a pretty tuberous rooted small herbaceous shrub, $\frac{1}{2}$ metre high, bearing in great profusion in the rainy season, very brightly coloured flowers made up of coloured calyx, having the appearance of corolla. Flowers are variously coloured and are funnel-formed with a long tube and expanded mouth. They close about 4 o'clock in the evening and open out in the morning and hence the common name, Four O'Clock Flower. The other popular name is Marvel of Peru. Plants come up rapidly from seeds which are produced in plenty. They are also grown from the tubers of previous year. Regular supply of water and rich soil give best results. The plant can be grown in pots, shrubberies or perennial borders. It dies down completely to all outward appearance in November-

December, and comes up again during the rains. *M. longiflora* bears longer sweet scented flowers.

Montbretia. (*Iridaceae*): Allied to Tritonias and grown very much like them. Showy and hardy summer-flowering bulbs with flowers of rich and brilliant colours borne on spikes, which are useful for cutting. They thrive in open sunny borders in rich soil, at medium to high elevations. Propagated by division or from seed.

Narcissus. (*Amaryllidaceae*): Genus of well known bulbous plants thriving only on hill stations, where they grow wild and freely bloom. Very few members of the family do well at low elevations in South India. Narcissii require light open soil composed of sand, leaf-mould, well decomposed manure and loam in equal proportions. Plant 5 bulbs in a 2.25 cms. pot, covering the bulbs with 7½ cms. of compost. In beds, bulbs may be covered 10 cms. deep. Till growth starts, very little moisture is needed. On the hills, bulbs are started in February.

Oxalis. (*Geraniaceae*): Oxalis is a troublesome dwarf weed with clumps of tuberous roots, leaves of an acid taste, and small pink flowers. Some improved garden species are worth growing. Oxalis is easy to grow; it may be grown in pots or on rockeries. Blooms are produced during the cold season and the plants die down by May, when the bulbs are rested and stored, like Achimenes. *O. Bowiei* is a large rose-flowered variety, which thrives in the plains. *O. hederoides rudra* bears yellow flowers and it has a contrasting bronze red leaves. This is a branching variety. Propagated by cuttings.

* **Pancratium.** (*Amaryllidaceae*) called the Spider-Lily. Bulbous plants, requiring little care to be bestowed upon them after planting them in open beds or borders. They are grown in pots also. Leaves are long and broad. Flowers are characterised by beautiful structures, known as staminal cups, having the texture of petals and being fringed and toothed in a variety of ways. The filaments growing out of the cup are long or short. The pure white deliciously fragrant flowers, having a spider-like appearance usually appear in the hot weather after a shower in large panicles measuring over a 30 cms. across. Pancratiums are moisture-loving plants-

and they should be never kept dry at the roots during period of growth. They bloom best if left undisturbed in their old soil or when pot-bound. Propagated by offsets, which are separated and potted off in small pots.

* **Polianthes tuberosa.** (*Amaryllidaceae*): Tuberose. (Canarese and Tamil: 'Sugandaraja' Hindi: 'Rajanigundo'). One of the commonest and handsomest of Indian garden plants, easily propagated by offsets and growing without any particular care. The plant is dwarf, about 12.5 cms. high, with radical light green long narrow arching crowded leaves. Flowers are single or double, waxy-white, sweet scented, tubular, 4-6 cms. long, and are borne in lax spikes on flower stems, $\frac{1}{2}$ metre high. The spikes of flowers are useful for cutting for vase-decoration and flowers are useful for making bouquets and button-holes. Cut away the old roots at the base of the bulbs and remove small sized ones attached to the larger bulb found in the centre of each clump of bulbs. It is only these larger bulbs that flower; the small ones take one or two seasons, according to their size, to bloom. Plant the large bulbs in the ground, 15 cms. apart, cover them with 3.75 cms. of fine soil. Stake the flower stalks to prevent injury from winds. Five large bulbs of about the same size may be grown in a 25 cms. pot, using Compost No. 3 on page 126. As Tuberose are strong feeders, supply plants with weak liquid manure once a week, during the period of vigorous growth when the flower-stalks are being pushed up. Trim unhealthy leaves. Bulbs can be rested and planted during any part of the year. By successional planting, blooms may be had all the year round.

Ranunculus. (*Ranunculaceae*): The Butter-cup or the Crow Foot is a lovely tuberous-rooted perennial of about 15 cms. in growth and of good form bearing brilliant handsome flowers of white, crimson, yellow, carmine and other colours. Individual flowers are often 5 cms. across, beautifully imbricated and double as a Rose. *Ranunculus* thrive only on hill stations and they require a moist sandy rich soil and a cool shady situation. They are grown like *Anemone* and *Gladiolus*, three bulbs being placed in a 22 cms. pot and covered over with a 5 cms. layer of compost.

Richardia. See under Calla.

Sprekelia. (*Amaryllidaceae*): *S. formosissima*=*Amaryllis formosissima*, known as the Scarlet Jacobean Lily or Malta Lily grows $\frac{1}{2}$ metre high with Amaryllis-like leaves and bears deep crimson flowers, which are peculiarly formed without a tube, vertically upon the scape. Blooms in the hot weather. Grown like Amaryllis. Suited for medium to high elevations.

Tigridia. (*Iridaceae*): So named after the spotted flowers. The species, *T. pavonina*, called the Tiger Flower, is the best known. Interesting Mexican plant, $\frac{1}{2}$ metre high, with bulb-like large corm bearing in summer, orange-red flowers with the centre spotted like leopard's skin. Best suited for hill stations.

Trinacria variegata looks like Canna; leaves, variegated yellow along the veins and flowers yellow. Height about $\frac{1}{2}$ metre. Grown like Canna.

Tritoma. See under Kniphofia.

Tritonia. See under Montbretia.

Watsonia. (*Iridaceae*): South African plants, $\frac{1}{4}$ metre to $\frac{1}{2}$ metre high, allied to Gladiolus and grown similarly. Flower spikes appear in the rainy season. Better bedding plants than Gladioli, hardier and having a longer duration of blooms. Require rich sandy soil and should be protected from excessive rains. Several effective species, all of them being suited only for high elevations.

* **Zephyranthes.** (*Amaryllidaceae*): Popularly known as Thunder-Flower or Zephyr-Flower or Wind Flower or Flower-of-the-west-wind. Hardy deciduous dwarf bulbous plants, 10-15 cms. high, with fine shining grass-like leaves and beautiful lily-like flowers, produced one on a scape. Wind flowers do exceedingly well in well drained sunny beds, borders or rockeries and patches of them on lawns have a cheerful effect. They are useful for edging walks and paths and flower beds. They burst suddenly into bloom nearly three or four times a year, soon after rains succeeding a spell of drought. If left undisturbed where they are, they bloom freely and in masses. When planting, put the bulbs 10 cms. apart and 5 cms. deep in the soil. In course of time, offsets crowd round the old

bulbs and fill up the entire length. There are several species, with white, pink, rose or yellow flowers. Hybrids of *Zephyranthes* with *Cooperia* (the white evening 'Crocus') introduced by Mr. Percy Lancaster and called *Cooperanthes* are more floriferous and exhibit greater variety of shades of colour than *Zephyranthes*. The following species of *Zephyranthes* are particularly worth noting:—

Z. Atamasco, flowers, large, nearly 7.5 cms. long and white, flushed pink. Scape 15-30 cms. high; *Z. Andersonii*, yellow flowers, flushed on the outside with red tint; *Z. flava*, golden yellow flowers; *Z. sulphurea*, bright yellow flowers; *Z. candida*, pure white flowers; *Z. rosea* and *Z. robusta* flowers, rose and pink coloured; *Z. carinata*, large rose-pink flowers; *Z. citrina*, true lemon-coloured flowers with bronze shading in reverse.

(B) BULBOUS FOLIAGE PLANTS

* **Caladium.** (*Aroideae*): Large genus of cormous aroids of South American origin, grown for the richness of colour and beauty of foliage. Very popular plants grown for decorating verandahs, dwelling rooms, corridors and conservatories or plant-houses. Usually grown in pots but they grow, quite as well, in the ground. It is impossible to describe the varied hues of the leaves which are strikingly ornamental. They are broadly arrow-shaped, peltate, are of a membranous texture and vary in size from a few cms. to a couple of 30 cms. The 'transparent' leaved varieties are the most favoured and costly. Colours vary from pure white to deep crimson, purple, bronze and pink and the leaves are conspicuously blotched and splashed with distinct colours in many kinds. Most of the species of *Caladiums* are deciduous, beginning growth in April or May and dying down for rest in October or November at medium elevations. October to February or March is their period of growth at Madras. Soil should be light, open and rich. It may be made up of equal parts of loam, sand, leaf-mould and well decomposed manure. Drainage should be perfect. Some charcoal pieces added to the compost will keep it sweet. A little addition of lime will augment the colour of the foliage. Start the dormant bulb (corm) by keeping it in sand kept moist for about a week.

It begins to sprout naturally in March. Put one large bulb into a 12 cms. pot with the crown slightly above the level of the soil and then shift to a 22 cms. pot; or two or three small ones into a 22 cms. pot. Plants remain compact and in better colour in limited than in considerable bulk of soil. Do not cover the crowns of the corms with soil. Water very sparingly till the leaf-sheath is about $7\frac{1}{2}$ cms. high. Then, gradually increase the supply of water with corresponding growth of the plant. Remove the flower, which appears usually before the leaves, as it takes away the strength of the coming leaves. Stake plants when they are sufficiently large. Give them a sheltered situation, where they are not exposed to severe direct rays of the sun, but do get a lot of light. In too shady situations, colours are not properly developed. Supply weak liquid manure (cow-dung water) once a week. The foliage loses its brightness about the middle of September; then onwards, lessen the supply of water gradually and stop it, when the leaves completely die back. Turn down the pots and when the soil is completely dry, take out the bulbs for storing or store with the pots in a dry cool place.

The following two species are valuable as edging plants:—

C. argyrites. (Syn. *C. Humboldtii*) is a dwarf type, about 15 cms. high; leaves are small, green and white. Suited for edgings and ribbon borders. *C. bicolor* grows about 30 cms. high. Leaves are bright pink, with green borders and are showy. Suitable for edging.

Calathea. See under Maranta.

Colocasia. (*Aroideae*): Plants allied to Alocasias and Caladiums and grown similarly. *C. gigantea* and *C. antiquorum* are two large growing species, which are usually cultivated. *C. antiquorum* variety *escudenta* produces large leaves and tubers which are edible and are used as vegetable.

Heliconia. (*Musaceae*): Foliage plants allied to Musa or Plantain with large striking leaves, coloured and beautifully marked in several species. They are grown in large pots like Canna and are useful for decoration of ferneries and for growing in beds in shade gardens. They should be shaded

from direct sunshine, watered liberally while in vigorous growth, and somewhat sparingly between November and April, when they take a sort of rest, without losing their foliage. Most of the species do not flower. Flower stalks of the species that flower should be removed. Propagate by division of rhizomes as in Canna. Start the pieces of roots in small pots and then transfer the plants to bigger pots. Use 40 cms. pots for final potting, in which the plants make quite a good show. Heliconias are at their best during the rainy season. Following are a few of the more ornamental species.

* *H. aureo striata* (Golden striped): 1 metre large handsome broad leaves, striated with yellowish parallel transverse lines; stem is striated with yellow and green; a noble plant.

* *H. illustris* ; 1 metre; leaves, large, coppery, striated with bright pink lines.

H. insignis grows 1 metre. Leaves, bright bronzy green, long, narrow and wavy.

* *H. rubra* is a very desirable species growing metre, with large leaves, brown and bronze.

* **Maranta.** (*Marantaceae*): Marantas and Calatheas are closely allied tropical plants, mostly natives of Brazil, cultivated for their highly ornamental foliage, the leaves being variously marked with shades of green, red, brown, yellow and white. They are rhizomatous plants with creeping underground stems. Some species are deciduous during the period of rest and some are evergreen. In horticulture, Calatheas and Marantas are confused with each other and they are treated alike, and all of them are known only as Marantas. All are easily grown in conservatories in shade. Protection from strong sunshine is very essential, as it destroys the foliage making it unsightly. Marantas are moisture loving plants but stagnation of water at the roots should be particularly avoided by providing efficient drainage of the soil. Syringing with clear water preserves around the plants a humid atmosphere, which the plants need. Artificial manures should not be used. Soil best suited for growing Marantas is one which contains equal parts of sand, loam,

leaf-mould, well rotten manure and some peat. Marantas are propagated by division of rhizomes. In February-March, the plants are taken out of the pots, the roots are washed free of soil, best healthy portions are selected, and a number of pieces containing roots and buds of their own are cut clean and potted in the soil recommended above. They may be started in small pots and shifted to larger pots according to the size of clumps formed. The following are noteworthy species:—

C. Leitzii, 45 cms.; *C. Lindenii*, $\frac{1}{2}$ metre; *C. Sanderiana*, 30 cms.; *C. medio-picta*, 45 cms.; *C. tigrina*, similar to *C. zebrina* but distinct from it; *C. zebrina*, $\frac{1}{2}$ metre; *C. Massangeana*, about 30 cms.; *C. Veitchii*, $\frac{1}{2}$ metre; *C. Makoyana*, 30 cms.; and *C. cannaefolia*, 40 cms.; *C. roseo picta*, 35 cms.; *C. bachemiana*, 15 cms.; *C. clussoii*, 25 cms.; *C. insignis*, 20 cms.; *C. Kigeliana*, 15-20 cms.; *C. metallica*, 35 cms.; *C. ornata* Roseotinesta, 30 cms.; *C. ornata Sanderiana*, 25-30 cms.; *C. picturata Vandeheckei*, 20 cms.; *C. princeps*, 35 cms.; *C. roseapicta*, 20 cms.; *C. undulata*, 20 cms.; *Maranta leuconeura Kerchoviana*, 15 cms.; *M. leuconeura massangeana*, 15 cms.; *C. pavonii*, 25 cms.

* **Rex Begonia.** See under Begonia. Page 430.

* **Xanthosma Lindenii.** (*Aroideae*): Also known as *Phyllo-taenium Lindenii*. Very good looking tender foliage plant, resembling an *Alocasia*, with large arrow-shaped peltate leaves, brilliantly marked white along the mid-rib, with parallel creamy yellow veins running therefrom. Grown like *Alocasia* and *Anthurium*. Propagated like *Alocasia*. Native of Columbia.

Zingiber Darceyi. (*Ziniberaceae*): Variegated Ginger. Tuberous rhizomatous plant $\frac{1}{2}$ metre long with leaves and stem variegated green and white, like *Alpinia vittata*. Propagated by division of rhizomes. Growing season is between April and November and the resting season from December to March.

CHAPTER XXVII

ORCHIDS

There are few flowers which show such diversity in form, size and colouring as orchids. The blooms are of wonderful beauty ; they are often gorgeously coloured, and peculiarly and fantastically shaped, mimicking forms of birds, spiders, scorpions, moths, butterflies and several other insects. The flowers are either solitary or are borne in clusters, spikes, racemes or panicles. In orchids, flowers last very long, as long as three months in some kinds.

Orchids form a very large family of plants, comprising of hundreds of genera and thousands of species and varieties. They are very widely distributed in several parts of the tropical zone, especially in the forests of India, Java, Sumatra, Borneo, Straits Settlements, South America, Mexico, West Indies, and South Africa. Several beautiful species are found there, growing in the crevices of rocks upon moss-grown spots or upon the branches and trunks of trees, in places where humidity and shade abound, and bursting into bloom, just about the time of the monsoon, in the months of June and July and also in September and October.

About two hundred years ago, only very few species of orchids were known to European horticulturists. It was the proud privilege of the rich only to possess them. The lovely flowers naturally awakened the interest of all plant lovers who spared not trouble and expense in collecting several beautiful specimens from their native homes. Societies were formed to send out collectors, to distant lands. Though collections were made in this way, successful cultural knowledge of orchids was only very gradually acquired, with the increasing knowledge of the several species and conditions of their growth in their native environments. In the latter half of the 19th century, several hybrids were raised successfully by a careful study of the peculiarities of the flowers and the arrangement of their different parts. On account of the patient and strenuous efforts of specialists at

hybridization, several lovely species and varieties now find a place in our gardens, at comparatively little cost.

The typical flower of an orchid has a perianth arranged in two whorls. The three sepals of the outer whorl are more or less alike and coloured like petals. The inner whorl consists of three petals. Two of these—the lateral ones—are alike, narrow, and the other one called the lip or the labellum, is large and broad and more fancifully and better coloured than the lateral petals. The lip is either lobed or spurred or it assumes wonderfully quaint and beautiful shapes such as a pouch or a slipper or a butterfly poised over a plant and the like. The beauty of the flower and its peculiarity much depend on the lip which acts as a convenient landing place for the insects which are attracted to it by its colour, in search of honey. The stamens and pistil in orchids are united into a column opposite the lip. The parts of the flower are so placed that self-pollination and consequent weakening of the offspring is avoided. Though the study of fertilization of orchids is very interesting amateurs do not attempt raising new kinds as it takes some years before flowers can be obtained from seed.

The structure of an orchid plant has an intimate bearing on the natural conditions which obtain in their native homes. As most orchids grow on branches of trees or on rocks, where after the rainy season, they are exposed to long periods of drought during which they get no food or water, they develop, what are known as pseudo-bulbs and thick leathery leaves in both of which they store, like bulbous plants in bulbs, starch, food and water as reserve supplies to sustain them during the period of drought. Further, they send out long aerial shoots which not only enable them to cling to trees and but also help them to absorb moisture from the air and food from the dust that collects around the roots or is washed down to them during rains.

Orchids may be generally classified to fall under any one of the following heads:—(1) Terrestrial or Ground orchids, which grow more or less in soil and have their roots imbedded in it, from which they absorb the nourishment necessary for their growth. The great majority of orchids from the

temperate zone are terrestrial. (2) Epiphytic orchids, which grow upon the branches of trees, having their roots exposed to air, from which they imbibe all the nourishment requisite for their growth. These, though they cling to trees and grow on them, are not parasitic, as they do not get their nourishment from them. Many of the epiphytic orchids are from tropical zones, (3) An intermediate class of semi-terrestrial orchids like the *Renantheras* which, besides sending roots to the ground and deriving partial nourishment therefrom, also develop aerial and adventitious roots, with which they cling to trees for support and get their chief nourishment by absorbing moisture and food from the air, and (4) Saprophytic orchids which live on dead matter. These are very rare.

In order to succeed in the cultivation of orchids, one should try to place them in conditions similar to those obtaining in their native homes. As they come from countries varying considerably in soil, rainfall, temperature, climatic conditions and altitudes ranging from the sea level to 2000 metres above it, it is the first business of the orchid grower to find out the native country of each plant and to study the climatic conditions prevailing there and also the habits of the plants. These are ascertained from geographical text-books and standard works on Orchid culture. The grower should then try to reproduce these conditions as closely as possible. Those belonging to dry regions fail often, when removed to wet places and *vice versa*. But, like many other plants, orchids often adjust themselves to altered conditions. Most orchids are lovers of shade and abhor direct sun. Some are hardy however, and grow when exposed to sun.

In England and such other temperate countries, orchid growers have to build three separate glass houses fitted with hot-water pipes for producing different temperatures and humidity and for regulation of shade, but in India, except in the hottest and driest parts and on high hill stations, one need not construct special orchid houses. In most places in India, the fernery or the grass-conservatory covered with creepers and kept cool inside by syringing water on the plants and the ground, answers the purpose of an orchid house. But, a

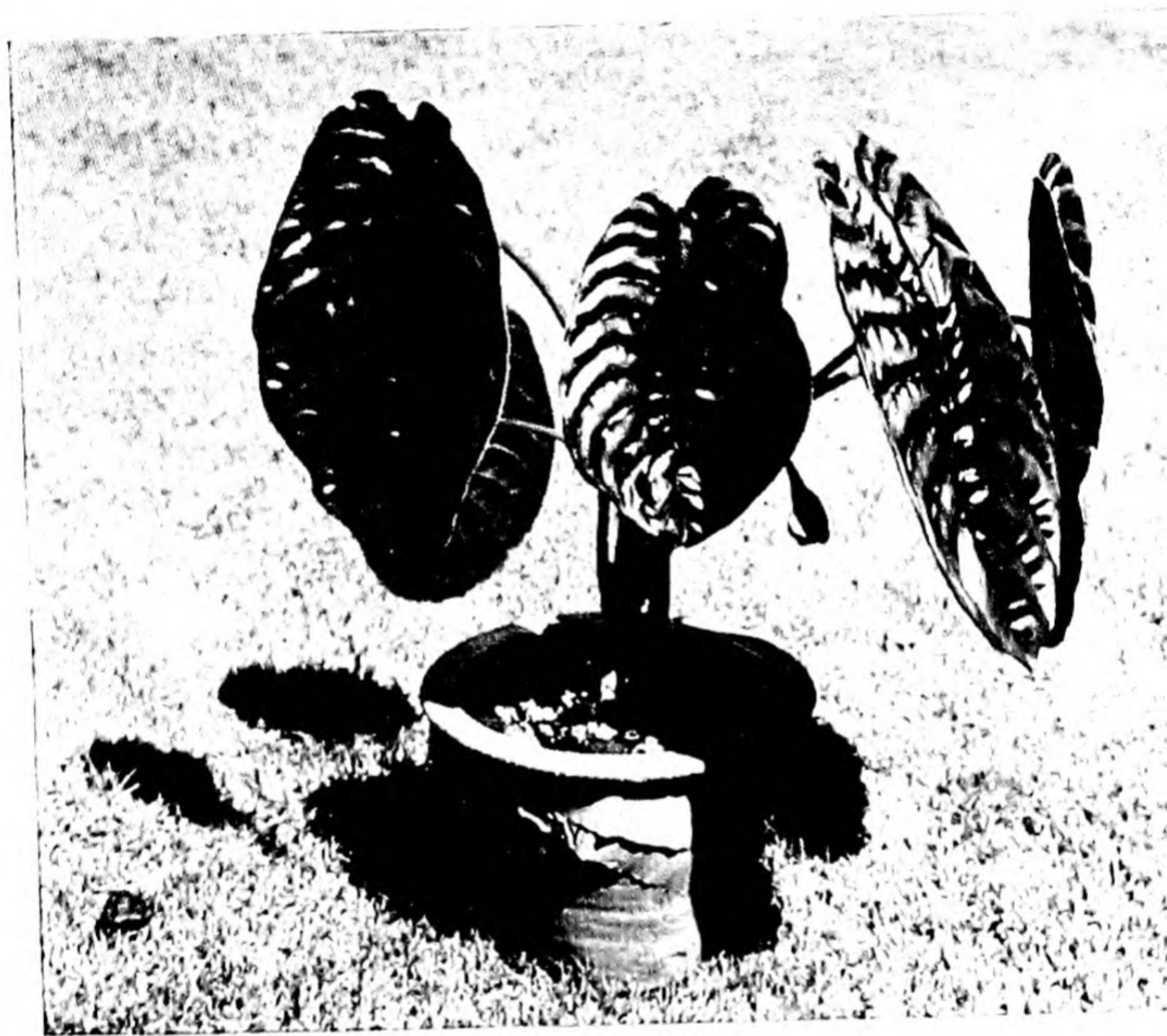


Plate 6 : AIOCASIA CUPREA METALLICA

glass house shaded from severe sun would no doubt be more agreeable if one could afford it.

Orchids are grown either on logs or blocks of wood, or attached to trees, or in wooden or wire baskets or in pots, or in ground according to the habit of the kinds in question. Orchid pots are special pots containing a number of holes on the sides for free aeration of the roots which they need.

Terrestrial orchids are, as a rule, cultivated in pots, pans and hanging baskets, filled with soil composed of knobs of charcoal, bricks broken into small sizes from the size of a pea to a walnut, coarse decayed leaf-mould and fibrous loam and peat. The pot is filled to one-third its depth with pieces of brick and well cleaned crocks for drainage. A layer of moss or cocoanut fibre is placed over the drainage material to prevent superincumbent layer of soil from getting down and blocking the drainage holes. For compost for orchids, see page 127. The plant is put on the compost in the pot and steadied up by building loosely around it, pieces of charcoal and brick and finishing off with a dressing of peat and moss. If the plant has pseudo-bulbs, care should be taken that they are not immersed in the compost and are placed above it or they rot away and die. In no case, should the crown of the plant be covered over by soil. Hardier kinds may be potted in compost containing sand, red earth, leaf-mould and well rotten cow-manure in equal proportions.

A different treatment has to be adopted with reference to epiphytic kinds. They hardly require any kind of soil. They are best grown on logs of wood such as those of the Mango, with rough bark and free from disease. Sometimes, epiphytic kinds are grown attached to square blocks of teak wood. For attaching the plants to logs or blocks as the case may be, the following plan is adopted:—Some moss is placed on the log; the plant is placed over it and roots spread on it; more moss is put on the roots; the plant is kept in position by passing round the log and over the moss strands of thin copper wire or strong thread. The moss is kept moist. The plant sends out aerial roots which cling to the supports in course of time. Epiphytic orchids are also often grown in undersized pots having holes on their sides using the compost mentioned in

page 127.

As a general rule, the period soon after the flowering season is the best for potting or repotting orchids. Repotting is undertaken only when necessary. Any plant, which has gone bad and is ailing on account of unsuitable material ought to be repotted at once irrespective of the season. Small pots should be used in proportion to the size of the plants.

True epiphytic require no manure. Chemical manures are most injurious to orchids. Liquid manure prepared from cowdung or from soot is useful in connection with terrestrial orchids.

Orchids generally pass through three periods every year. They are :—(a) The growing period, which is during the rainy season. They absorb nourishment and keep growing, storing water and food in the pseudo-bulbs. (b) The resting period, which, in the majority of orchids, is from November to March. They lie dormant and ripen during this period. (c) The blooming period is when the plants wake up from their slumber, burst into bloom and produce seed for perpetuation of the species.

The resting period of each plant is to be watched and noted for different treatment. One can make out its resting period from the appearance of the plant. Those kinds which shed their leaves, show how much rest is necessary. The starting of fresh growth indicates when the growing conditions should be restored. In respect of the very small growing evergreen species, it is much better to ignore the resting season, rather than to lower their vitality by severe drying off. Varieties with pseudo-bulbs or bulbs can stand drought more easily than those that have only roots.

Care has to be exercised in watering orchids. Meagre watering, without doubt, injures and destroys them; over-watering without regard to the period of rest, etc., is certainly harmful. During the resting period, orchids require little or no water or only so much as is sufficient to keep them alive. As soon as they are repotted or top-dressed with fresh soil they should be sparingly watered for the first few days and the quantity of water is to be increased as more and more growth is made. Plenty of water is given during the period

of vigorous growth. The entire material in the pot should be moistened through at each watering, watering being done however, only when the soil is drying up. Light syringing during the day is beneficial.

Cleanliness is very essential in orchid culture. Every material used should be clean. Clean crocks, disease-free logs or blocks of wood, fresh pots and sweet clear water are necessary. Damaged leaves and those that have turned yellow with age should be cut away clean where they join the stem. Old bulbs should be removed at potting time and if they are likely to be of any use, they may be independently potted. Unhealthy parts should be removed and burnt.

Orchids are gathered and forwarded during their period of rest. Freshly collected plants at mid-resting time are the best for transmitting. As soon as they are received, they are trimmed and the damaged parts are removed. They are then sponged and suspended in a cool place for a few days and then potted in small pots. Orchids having pseudo-bulbs are not watered but are sponged occasionally until growth commences, when they are potted in the usual way. Those, without pseudo-bulbs, may be treated similarly but better results may be obtained by immersing them in water for about five minutes every day.

As a general rule, propagation of orchids is effected by division of clumps of pseudo-bulbs or stems after flowering. Some are easily increased by dividing them into pieces, not injuring the roots in the process of division and taking care to see that each bit has roots attached to it. The pieces are potted in small pots and do not receive much water till growth commences. Such plants as *Renanthera*, *Aerides* and *Saccolabium* grow easily by cuttings, the only precaution to be observed is that each cutting should have a few aerial roots for its sustenance until it has become established; till then, its lower end is kept moist with a binding of moss. The best time for propagation is just before the plants begin to grow, that is, in the month of February or so. Propagation from seed is quite possible but it is seldom resorted to by amateurs as it is difficult and takes long—some years, before one can get plants to bear flowers.

Orchids are attacked by thrips, red spider, slugs, snails, wood-lice, cockroaches, mealy bugs, scale-insects, etc. Fumigation and sponging with insecticides are resorted to eradicate pests. Diseased plants should be segregated from healthy plants and they are better destroyed if suffering badly.

For cultivation in the plains and elevations up to 400 metres among the epiphytic orchids may be selected, Vanda, Aerides, hardy species of Dendrobium, hardy kinds of Renanthera, and Saccolabium. Among the terrestrial orchids, the following may be selected:— Spathoglottis, Phaius, Thunia and Cypripedium.

SELECT ORCHIDS

Aerides. The name Aerides is derived from a Greek word meaning, air plant. True epiphytes with pleasing evergreen foliage and leafy stems without pseudo-bulbs. Natives of India, Malaya Archipelago, and other nearer parts. Flowers are borne in dense arching spikes of rose-purple, blush-pink, buff, or white and purple. In some species, they are fragrant. As the stem is evergreen and as there are no pseudo-bulbs storing nutrition, the plants should be watered with care without allowing them to get dry. The roots are mostly aerial and hence, the plants require very little potting material—only just enough to anchor the plants in the pots. Most kinds are suitable for growing in baskets. Care should be taken not to injure the roots. The following species are noteworthy:—

* *A. odoratum* with leaves 15-20 cms. long by about 5 cms. broad and racemes of flowers longer than leaves. Flowers are very fragrant, being lemon-scented, are white, tipped with magenta. Native of Assam.

A. affine a variety of multiflorum bears long spikes of rose coloured flowers.

A. crispum is a native of South India. Flowers, white suffused with purplish rose, nearly 5 cms. in diameter. Racemes are many flowered and last long.

A. multiflorum bears flowers whitish, flushed and tipped on branches sometimes $\frac{1}{2}$ metre in length.

Arundina bambusifolia. Terrestrial orchid with large leafy reed-like stems, 1½ metres tall. Flowers are pink, shading

to crimson, about 10 cms. long. Best grown in a large pot or tub in fairly rich soil in open sunlight. Native to Ceylon and India.

Bletia. Terrestrial orchids with leafy stems arising from the apex of pseudo-bulbs and bearing blooms on lateral leafless stems. Blooms are purplish or white and are borne freely in erect terminal spikes in well established plants. They should be kept fairly dry during winter, when plants are at rest. Repotting is done in fresh material when growth begins in February–March.

**B. hyacinthina* = *B. striata*. Native of China, Japan. Is hardy, bears abundance of purplish red flowers in February and March. Grown in shallow pots.

B. verecunda and others.

Calanthe. Calanthe, from two Greek words, meaning beautiful flower. They are mostly terrestrial. Few are sub-epiphytal. Easily grown in pots. They are special favourites of amateurs as they are easily managed and produce an abundance of showy flowers, lasting a long time in perfection. Most of the species are deciduous and have broad plaited leaves and bear erect many-flowered scapes, shedding the leaves about the flowering season in the late summer. Water sparingly during rest and till flowers are cut. Pot each year in fresh compost, taking care to secure efficient drainage. With Calanthe, it is necessary to depart from the usual style of potting orchids; instead of elevating them above the rim of the pots upon a cone of peat and moss, they are kept below the rim, as in potting and other ordinary kinds of plants. Liquid manure may be applied occasionally when the plant is vigorously growing. Propagation is by separation of bulbs.

C. veratrifolia; a native of Malaya and moist districts in Northern India; is an evergreen, with broad many-ribbed wavy leaves about $\frac{1}{2}$ metre long, produced from creeping rhizomatous roots. Flowers are white with lip pale pink or dull yellow and are freely borne in dense corymbose racemes, $\frac{1}{2}$ – $\frac{3}{4}$ metre long, in June–July. Being an evergreen, should be kept fairly moist all the year round.

**C. vestita* with its varieties is a very popular orchid, with long leaves, $\frac{1}{2}$ metre long, bearing numerous whitish

flowers, nearly 7.5 cms. across, in racemes. The species is deciduous, needing a fairly dry resting season. Native of Burma and Malaya.

C. Masuca is a native of North India. Flowers are deep violet, fading to lilac, and are borne in late summer.

C. purpurea. Flowers are pale purplish-pink.

***Cattleya.** Very beautiful flowering evergreen epiphytic genus. Most species are natives of Central and South America, especially Brazil. Flowers are borne singly or in clusters, usually at the apex of the pseudo-bulbs and rarely on leafy stem arising from the base of the pseudo-bulb. Flowers are very showy and often measure 7-9 cms. across from tip to tip of the petals. They also keep fresh for 10-12 weeks. Propagation is very slow and it is accomplished only by cutting the rhizome between the bulbs, leaving the parts where they are until new growths and roots are made.

C. labiata is a native of Brazil. Flowers measure 15-20 cms. broad and 20-25 cms. deep; the sepals and petals are pale rose, and the lip is large and broad, of a rich deep purple or violet in front, and having a large, yellow eye-like blotch on each side of the throat.

C. Gaskelliana; **C. gigas*; *C. Skinnerii*; **C. Mendelli*; **C. citrina*; *C. Bowringiana*; *C. Eldorado*; **C. Warscewiczii* and others.

Coelogyne. Genus of pseudo-bulbous epiphytic orchids, free flowering and easy of culture. Flowers are borne in loose racemes springing from the bases of pseudo-bulbs. Their habitat is Nepal, Burma, India, Malaya and China, often at high elevations. They are best grown in pots; increased by division directly after flowering period; repotted also at the same time. Coelogyne have a distinct dry resting season and they require an abundant supply of water during growth.

**C. cristata* is a native of Nepal, bearing long 5-9 flowered drooping racemes. Flowers are 10 cms. across, have white sepals and petals, with beautiful yellow and orange stains on the lips.

**C. flaccida* is a native of Nepal; an erect free flowering variety of great beauty. Racemes are many-flowered, long and pendulous. Flowers are scented, sepals and petals are

pure white, with lips stained with pale yellow and crimson.

**C. Dayana* has leaves, $\frac{1}{2}$ metre long, tall habit and bears lemon-yellow flowers, in many flowered drooping racemes $\frac{1}{2}$ metre long.

C. odoratissima is a native of the Nilgiri Hills and Ceylon, bearing slender racemes of white flowers, with lips stained with yellow in the centre. Very sweet-scented flowers.

C. asperata is from Borneo, with long pseudo-bulbs and leaves $\frac{1}{2}$ metre long and bearing long drooping racemes 30-45 cms. long of fragrant creamy-white flowers 7 cms. across with brown streaks.

C. mysorensis is another handsome species.

Cymbidium. Cymbidiums are intermediate in character between true epiphytes and terrestrial orchids, growing in nature in clefts in trees and in such places where there is an accumulation of dead leaves. They should be grown in soil, containing rough loam, broken bark, dead leaves and broken pots in equal parts. Most of them are plants of large size with narrow elongated more or less arching leaves and bearing flowers in erect or arching, occasionally pendulous racemes. There are a number of species bearing decorative blooms in long spikes, often $\frac{1}{2}$ metre in length. Native of Burma, Ceylon, Malaya Archipelago, India and China.

C. bicolor is an epiphyte with drooping spikes, many-flowered. Flowers are creamy-yellow, stained with splashes of reddish purple.

**C. giganteum* is a native of Nepal, with dull purple flowers, striped with purple.

**C. eburneum*; 7-15 flowers, 7-10 cms. across arching racemes. Flowers fragrant, yellow marked with brownish transverse lines, tip yellow and bloched crimson.

C. Lowianum; *C. aloifolium* and others.

Cypripedium. An interesting large genus of hardy terrestrial plants, with labellum forming an inflated pouch, resembling a lady's slipper. Hence, called popularly, Lady's Slipper or Venus Slipper. Plants are herbaceous and have no pseudo-bulbs. They have fairly thick roots requiring plenty of pot room. Hence they should not tack moisture. They do not want to be elevated above the rim of the pots but should be

inserted in the same manner as ordinary plants. Propagation is usually by division. Seeds germinate freely.

C. concolor is a native of Burma with handsome variegated leaves and large pale yellow flowers.

**C. insigne*. Most popular, large flowers often 12 cms. across, apple green streaked and shaded brown purple and spotted and margined white.

**C. Fairieanum*; **C. Spicerianum*; **C. niveum* and **C. bellatulum* are a few others.

Dendrobium. One of the largest and most decorative genus of orchids, comprising of several hundreds of species and hybrids and varieties. All are epiphytic and are from many places as India, Ceylon, Australia, New Zealand, Japan, Pacific Islands and Malay Archipelago. Pseudo-bulbs are tufted or arise from creeping stems at intervals. There are two sections, the evergreen and the deciduous; the former should never be allowed to become dry at the roots at any time and the latter need a resting period, which is observed by finishing of growth about November and the swelling of buds about February for flowering. The pseudo-bulbs, after they have flowered, may be removed as they are not of any use to the plant. Flowers are in the majority of species very showy and are produced in long and lax, or short and dense racemes of a drooping habit. Hence, several Dendrobiums may be grown in hanging baskets with advantage. They may also be grown in perforated pots. Some do well, attached to trees with a little moss or cocoanut fibre. The following are few noteworthy species:—

D. calceolaria; Flowers, large, pale yellow, produced 12 or more together on a raceme; throat is brownish crimson. Large robust growing species, native of India.

D. Dalhousianum has stems 1 metre high. Flowers, large, yellow and rose, in racemes. An evergreen species, native of Burma and India.

**D. densiflorum* is also an evergreen species, native of India and Sikkim. Flowers are profusely borne in dense drooping panicles, are yellow with orange lip.

**D. Draconis*; flowers white, with a reddish lip, produced twos from points of matured growths.

D. Farmeri; upright, evergreen species, about 30 cms. high, from India and Burma. Flowers have the sepals and petals pale yellow tipped with pink, and the disc of the lip, golden yellow. A beautiful species producing large long pendulous racemes like the *densiflorum*, but with flowers not so closely set together.

**D. Aggregatum*: 2 to 12 flowers, deep yellow in arching racemes, one leaved, short winged, wrinkled pseudo-bulbs.

**D. fimbriatum*, native of Assam. A showy evergreen species, bearing large handsome trusses of bloom. Flowers, about 10 cms. across and of a deep orange yellow colour. *Variety oculatum* has a blood-coloured spot on the base of the lip.

**D. Mac Carthiae* is a native of Ceylon, requiring a hot and moist climate. Stems are slender and $\frac{1}{2}$ metre high. Flowers are rose-pink, nearly 7.5 cms. long, produced in drooping racemes, containing 3 to 5 blooms.

D. moschatum (musk-scented) is an evergreen species, from East India, with large flowers, creamy-white tinged with rose, borne in racemes of 8-14 flowers. Flowers are large, over 5 cms. across, with lip, slipper-shaped, pale yellow, with base darker coloured and ornamented on sides by large eye-like blotches of deep blackish purple.

**D. nobile* is an indigenous lovely plant while in bloom. A beautiful easily grown species, very attractive grown in large pots as specimens. Flowers are freely produced, large, nearly 5 cms. across, white and deeply tinged with violet with two club-formed deep purple spots on the base of the lip. Produced in 2 or 3's from 2 years old pseudo-bulbs.

**D. Parishii*, a deciduous species, bearing flowers, purplish-rose fading into white towards the centre. Pseudo-bulbs stout 2 cms. in diameter.

D. Pierardii is a native of India, a hardy species, with flowers creamy-white or delicate pink with a primrose lip and produced on long pendulous stems.

D. regium is indigenous to India and bears large flowers, 6 cms. wide and purplish blue.

**D. Phalaenopsis*, native of New Guinea. A charming variety, with graceful flower-spikes, attractive for several weeks.

**D. thyrsifolium* ; **D. Wardinum* ; **D. superbum* ; **D. formosum* are a few others.

Epidendrum. Genus of varied plants, not all of them attractive; a few are showy, bearing fragrant flowers.

E. radicans is epiphytic; a native of Mexico, with long and scandent stems and terminal flowers of bright orange-scarlet colour.

Grammatophyllum. *G. speciosum* is the Giant Orchid, with stems $1\frac{1}{2}$ –2 metres long. A giant Malayan epiphytic species. Flowers are produced in stout erect racemes, $1\frac{1}{2}$ –2 $\frac{1}{2}$ metres in length, springing from the base of the pseudo-bulbs. Flowers are very large, about 15 cms. in diameter, yellow, spotted with deep red-purple. Rather a shy bloomer, difficult to grow.

***Laelia.** A very showy group of plants, including some hybrids of *Cattleya*, bearing large and attractive flowers, borne singly or in two or many flowered racemes, rising from the top of pseudo-bulbs, which have one or two leaves. All are epiphytes and closely related to *Cattleya* and requiring similar cultural treatment.

**L. Cattleya* hybrids are very showy and costly plants.

L. grandis; *L. purpurata* and *L. superbiens* are some others.

Oncidium. **O. luridum* is an epiphyte, native of West Indies. Flowers are yellow, blotched with brown. Leaves, $\frac{1}{2}$ – $\frac{1}{2}$ metre long and leathery.

**O. Papilio* is the famous Butterfly Orchid, bearing large butterfly-shaped flowers. Also from West Indies.

***Peristeria.** *Peristeria elata* is the famous Dove Orchid or the Holy Ghost Flower. Native of Panama. Tropical American terrestrial orchid with pseudo-bulbs, 10 cms. long, with strong veined leaves, $\frac{1}{2}$ metre long, bearing flowers sweet-scented in tall spikes. Flowers are waxy white, globose with the centre resembling a dove. Grown like *Calanthe*, but does not require so much rest.

Phaius. *Phaius* are vigorous growing terrestrial orchids, natives of Tropical Asia, Africa, Australia, China, Japan and South Sea Islands. They are large growing with ample foliage and tall clustered stems terminating in racemes of very showy flowers. They delight in well drained fibrous soil, supplied frequently with liquid manure, and they delight in moisture

throughout the year. Propagated by division of dormant pseudo-bulbs.

**P. grandifolius* is a noble species. Flowers are 7 to 10 cms. across; sepals and petals of brownish colour within and white without; lip, white with dark crimson; brown throat. Spikes are $\frac{1}{2}$ to 1 metre tall and many flowered and well adapted for cutting.

**P. Wallichii* is a native of the Himalayas and Assam. An excellent terrestrial hardy orchid, with folded lance-shaped leaves about $\frac{3}{4}$ metre long, with large tall upright spikes of flowers which are long, nearly 10 cms. across, orange-yellow with a brown throat. Protection from afternoon sun and good supply of water while growing are necessary.

P. Blumei is a native of Java and Ceylon. Very much like *P. grandifolius* but with light yellow flowers with splashes of red.

Phalaenopsis. Very attractive epiphytes, known popularly as Moth Orchids. They have short leafy stems and no pseudo-bulbs. Leaves are few, only a pair or so, thick, leathery and mottled handsomely in some species. Flowers are very showy, resembling moths, and borne loosely in long racemes. In a collection, one or more of the plants will be in bloom throughout the year. Plenty of water at growing time should be given as the leaves are broad and as there are no pseudo-bulbs. They are grown in perforated pots, baskets or on blocks of wood. Provision should be made for sufficient moisture always. Propagation of *Phalaenopsis* is very difficult, the plants seldom affording an opportunity for division. Sometimes young plants form on old flower stems and these should be left until they emit roots, when they may be removed and potted and carefully watered till they are established. The following are some of the handsomest species:—

**P. amabilis* (Lovely) is a native of Malaya and Java. A very handsome species, with large flowers which are often 12 cms. in diameter, pure white, spotted with red. Panicles, very fine and branching. Grown in baskets, made of strips of wood and protected from direct sunlight and watered freely throughout the year, best results are obtained.

**P. javanica* is similar to the above. White flowers.

**P. Schilleriana* is a native of the Phillipines. A very beautiful species with flattened frosted roots and leaves, broadly oval-marked, with transverse bands and blotches of light green on rich green. Flowers, slightly fragrant, rosy mauve with dark purple spots on the lip, arranged in two rows along the spike.

Renanthera. Showy epiphytal orchids, natives of Burma and Malaya Archipelago, with long creeping stems and flowers borne in loose long racemes.

R. coccinea has stems $1\frac{1}{2}$ to $2\frac{1}{2}$ metres long and creeping. Flowers are borne in long loose racemes. They are pink, spotted with crimson and very showy and borne in profusion in long successions.

R. Imschootiana is a compact free growing species with showy crimson-rose flowers. Like *Vanda caerulea* in habit.

R. Maingayi = *Arachnanthe Maingayi* is the Scorpion orchid. Native of Burma.

***Rynchosstylis retusa.** Popularly known as Fox-Tail Orchid. Formerly known as *Saccolabium guttatum*. An epiphyte, with two ranked, stiff, leathery leaves and strong thick roots. Flowers are white, spotted with purple-pink, very showy, clustered closely in dense cylindrical drooping or pendulous racemes. Cultivated like *Aerides*. Does well in perforated pots in ordinary soil composed of leaf-mould, loam, charcoal bits and a little peat. Makes a good show in hanging baskets. Native of the Western Ghats and of hot moist districts from the Himalayas to Ceylon.

Saccolabium. The name, from *saccos*, a bag, and *labium*, a lip, in allusion to the bagged labellum of all the species. *Saccolabiums* are epiphytic orchids with erect leafy stems and no pseudo-bulbs, increasing in length by growth at the apex. Leaves are distichous, leathery and fleshy. Flowers are generally small but are borne profusely in large dense clusters, exquisite in colour. *Saccolabiums* are grown like *Aerides*, *Vanda* and *Phalaenopsis*, in baskets or on blocks or attached to trees. Native of Cochin-China, Borneo, India, Java and Phillipines.

S. giganteum (*Syn Vanda densiflora*) is a native of Burma. Flowers are sweetly perfumed and freely produced in long dense drooping racemes, and are white spotted with violet.

S. Wightianum is a native of Ceylon bearing light yellow flowers, tinged with red.

S. Blumei (*Rhyncostylis retusa*). See under *Rhyncostylis*.

Spathoglottis. Terrestrial orchids, natives of East Indies. South China, Malayan Archipelago, Pacific Islands and Australia. They are very hardy and do well in the plains too and are grown like any other ordinary plants. They bear racemes of flowers on erect scapes and have to be treated like *Bletias*.

S. plicata with pink, white and purple varieties. Flowers produced in spikes, $\frac{1}{2}$ – $\frac{3}{4}$ metre long.

S. aurea bears bright yellow flowers.

Stanhopea. Remarkable epiphytic genus producing pendulous inflorescence. Native of Tropical America. Grown in wooden basket made of spars, using soil composed of coconut fibre, moss, pieces of bark and a little sand and leaf-mould. Moist atmosphere and plenty of water during growth are necessary. The spikes of flowers are often showy and scented but are short-lived. They are peculiarly produced emerging from the bottom of the basket.

S. eburnea bears ivory-white fragrant flowers.

S. tigrina bears flowers of red blotched with yellow.

S. grandiflora bears flowers, orange, crimson and yellow.

Thunia. Thunias are terrestrials. There are about 6 species and they are natives of N. India, Burma and South Himalaya region up to a height of about 1,500 metres. Thunias have tall bamboo-like stems bearing clusters of flowers at the top. Growth starts about February, when the plants are repotted using Compost No. 13, page 127. They are put in comparatively undersized pots, setting them rather high in the pots. Watering is done sparingly till growth starts. When shoots make headway, watering is done liberally and weak liquid manure is supplied while growth is rapid and vigorous. Flowers are produced about the month of August and after flowers are over, the leaves fall off and the plants need rest. During the resting season, just so much water is supplied as is enough to keep the plants alive; the old stems act as reservoirs of food for new growths next year and do not bear leaves again although they may remain for a year or two more, unless they are cut away. Thunias are propagated by cuttings of the old stems,

about 15 cms. in length, and inserted in sand or sphagnum moss.

**Thunia alba* grows $\frac{1}{2}$ metre high, with sheathing leaves about 15 cms. long, and bears drooping racemes which are 6 to 12 flowered, at the ends of the stems. Flowers are white, with the labellum veined with purple and nearly 7 cms. across.

**T. Marshalliana* is allied to the preceding species.

Vanda. One of the most attractive groups of orchids, natives of East India and Malaya Archipelago. They are graceful in growth and flower. All are epiphytic and can be grown attached to trees, blocks of wood or in hanging baskets. Following are some handsome and usually grown species:—

**Vanda caerulea* is one of the loveliest orchids, with very attractive large flowers, sometimes 12 cms. across. They are blue in colour and are borne in large sprays of ten or more flowers.

V. Roxburghii has stems $\frac{1}{4}$ – $\frac{1}{2}$ metre long and bears erect racemes containing 6 to 8 flowers, which are pale buff or grey with chocolate spots and blue lips. Native of Bengal.

V. teres has long and straggling stem and bears rose-magenta and orange-yellow flowers in small racemes. Native of India and Burma.

V. Hookeriana with cylindrical stem and crimson-purple and orange flowers.

V. tricolor is from Java; flowers are scented, yellow with brown spots.

CHAPTER XXVIII

WATER GARDEN

What is a water garden. Those, who have in their grounds, a shallow pond or a lake of natural formation, in which the water does not dry up in summer and does not overflow its banks in the rainy season, or if it does, can be conveniently led away, leaving its level almost constant in the pond, can convert it with the area surrounding, into an ideal water garden. It provides for the cultivation of the most fascinating and beautiful of (1) true aquatics, (2) bog or marsh plants and (3) moisture-loving plants, in harmonious and natural relationship with each other and the surroundings. Most aquatics do not need more than a depth of $\frac{3}{4}$ metre of water. Such, as the Sacred Lily and *Victoria regia* which require about 90 cms. depth of water may be grown in the centre of the pond. Such, as species of *Nymphaeas*, which need varying depths of water from 15 cms. to $\frac{1}{2}$ metre, may be cultivated in the shallower water near the margin. The edges of the pond could be hidden over and clothed with plants like *Veronica palustris*, *Calla palustris* and *Myosotis palustris*, which firmly rooting in the soil on the margin spread out over the surface of water. Beyond the margin of the pond, in the soil which is saturated with moisture, such water-loving plants as grasses, sedges, ferns could be grown. Moisture loving trees, shrubs, bamboos, pandanus, palms, etc., may be planted in such a way that the taller kinds afford shelter and effective background to the smaller plants in the foreground and the water area.

The Lily Pond. In the absence of such a natural pond as referred to above, a low-lying piece of ground might be selected and an artificial pond constructed there with concrete and cement walls and bottom, of a thickness of 15 cms. and a depth of $\frac{1}{2}$ metre. This depth of water is enough to cultivate most aquatic plants. The dimensions of the pond and its shape depend upon the available area, the quantity of water available, and the taste of the owner. A simple design

would be a rectangular pond, 50 cms. $\times$ 30 cms. or a square one of 4 metres. A pond of such dimensions could accommodate a number of varieties of aquatics and bog plants. The larger the area, the more impressive would be the results. A pond less than $1\frac{1}{2}$ metres in diameter is not worth doing. Provision should be made for an inflow pipe at the bottom of the pond. An outlet pipe, about 7.5 cms. below the containing wall, is necessary to keep the water in constant level in the pond so that the regions beyond it may not be flooded and the plants killed by stagnation of water. The pond should be constructed far away from trees as they would shed their shade and leaves into the pond and their roots would, in course of time, damage the walls of the pond. A very convenient and effective arrangement for growing waterside plants suitable for marginal work is this:— An inner concrete and cement wall, $\frac{1}{2}$ metre high, is constructed 5 metres parallel to the wall of the pond and the space between the two walls is filled with suitable soil and pressed down in such a way that it slopes from the top of the outer wall down to the top of the inner wall. This soil should be moist always, as the water level would be midway down the slope of the soil. Advantage is taken of the slope to plant kinds which love varying degrees of moisture.

Those, who are unable to maintain a luxurious Lily Pond, can satisfy their desire to grow one or two aquatics in a tub, $\frac{1}{2}$ metre wide and deep, sunk into the earth for pleasing effects, and filled with water by hand.

Testing the pond for planting. After constructing the pond, it is advisable to fill it with water and leave it for some time—at least for four weeks—to test it, against leakage and also to allow chemicals harmful to plant life and fish to soak out of the cement. Addition of sufficient quantity of crystals of potassium permanganate to the water to colour it just wine-red will be helpful to remove the toxicity quicker, within a week or ten days. After this period, the pond is emptied and is ready for planting.

Planting in the pond. The best time for planting aquatic plants is about the beginning of the monsoon—in May. The bottom of the pond is filled to a depth of about 20 cms. with

a compost made up of $\frac{5}{6}$ heavy loam and $\frac{1}{6}$ well decomposed cow manure. The latter can be dispensed with if bone meal is available. 114 gms. of it may be used for every sq. metre of soil. Aquatics planted directly into the soil, root freely and grow vigorously. But, a more desirable method of planting is to put them without bruising them, in the compost recommended above in pans or flat baskets, 40 cms. or more in diameter and 20-30 cms. deep, in their appropriate places in the pond—in which case, it is enough to fill the bottom of the pond with only 10 cms. of compost. The roots of the plants will in course of time come out of the baskets and ramble in the rich soil below. Those aquatics which require less than $\frac{1}{2}$ metre depth of water may be stood on wooden boards inside the water at suitable heights.

Filling the pond. — It would be wise to fill the pond in a few stages. Soon after planting the deep water-loving aquatics, water sufficient only to cover the crowns of the plants is let in. More water is let in only after new growths are made by these. This process is repeated till all the plants requiring less and less depth of water are put into the pond and the water brought to its permanent level. Filling the pond may thus take 8-10 weeks. This gradual filling reduces the casualties in the Lilies to a minimum and ensures their early flowering.

Care of the water garden. — Aquatic and marsh plants require very little attention, once they are planted. If they have grown too vigorously and overcrowded each other, they must be lifted and divided and replanted. This will have to be done probably once in two or three years.

Water happens to be the breeding place for mosquitoes. A few fish in the pond serve to eliminate the larvae of mosquitoes. Gold and other ornamental fish breeding adds a point of interest to the water garden. The leaves and stems of the aquatic plants afford shelter to them from King-fishers. A boulder or two in the water will also be useful for the fish as effective shelter.

The addition of a few water snails into the pond will help to the well-being of the pond, as they act as scavengers, cleaning up the waste plant and animal materials.

The water in the pond may become green and unsightly. This green may be disposed of by adding 30 gms. of permanganate of potash or 114 gms. of blue vitriol to every 125,000 litres of water in the pond. This small quantity of the chemical in the water is not harmful to the plants or the fish. If the first application is unsuccessful, a second application, ten days later, will be effective.

Aquatics for planting in the water.—The order Nymphaeaceae furnishes most of the desirable plants for the Lily Pool. Propagation, is in many cases from the 'eyes' or small outgrowths from the parent tubers, which are separated and put in small pots in the compost recommended above, with some sand all round them. When the pots are full of roots and the plants are growing, they are shifted into the baskets for planting in the pond. Propagation in most cases, is also from seeds. The seeds are sown in a shallow earthen pan in ordinary loam and this pan is kept in a tank or a slightly bigger pan and filled with water constantly. After germination, the seedlings are pricked into soil in 15-cms. pots and transferred finally to baskets.

The genus *Nymphaea* (Water Lilies) is the largest and the most important of true aquatics. *N. coerulea* bears narrow petalled sky blue flowers which open in the day and close in the evening and emit a delightful fragrance. *N. lotus* is a night bloomer, pure white and scented. Both the above species are natives of Egypt. The *N. stellata* kinds of Bengal which are similar to *N. coerulea* are also useful but are without scent. The Bengal *N. lotus* = *N. rubra* with its large brilliant red flowers is handsome. *N. lutea* bears showy yellow flowers. *N. sulphurea* bears pale to deep yellow flowers. The hybrids introduced by the Frenchman M. Marliac and called after his son-in-law, the Laydekeri, are free bloomers, easily raised from seed. There are several kinds recently introduced, as for instance, *N. Mrs. Richmond*, *N. Gladstoniana*, *N. James Brydon*, *N. odorata*, which are worth trying in our ponds.

Nelumbium speciosum, known as the Water Bean—The Scared Lily—the Lotus, is very beautiful in the hot season with large peltate leaves and large double pink or white

flowers. Its seeds and root-stocks are edible. *N. luteum* is the yellow Water Bean.

Victoria regia is the Giant Water Lily from S. America. In its native home, the leaves measure $4\frac{1}{2}$ metres and its flower 1 metre in circumference. It blooms in deep water in this country producing beautiful flowers about 30 cms. or more in diameter, of white flushed with pink. The leaves are 1 metre in diameter and are very interesting, resembling large tea trays on the upper surface. The lower surface is curious with a network of fibres with projecting thorns. As this Lily is short lived, fresh plants should be raised from seed every year. Germination is very slow—some times as delayed as two years.

Euryale ferox has large floating curious leaves with erect spines. Flowers are small and blue and are of no interest at all.

Aponogeton distachyum (Naidaceae). The Cape Pond Weed. Called also Water Hawthorn, because of the rich hawthorn-like scent emanating from the flowers, which are white with jet black anthers and float on water, along with the strap-shaped leaves. The bulb-like tubers can be put in pots and dropped into position in the water.

Limnanthemum indicum (Gentianaceae). Water Snow-Flake. Floating Nymphaea-like leaves. Dingy white flowers about 30 cms. across. Propagated by division or seeds.

Monochoria hastafolia (Pontederiaceae). Similar to Water Hyacinth, with purplish blue flowers. Propagated by division.

Pontederia (= *Eichornia*) *crassipes*. (Pontederiaceae). Water Hyacinth. Upright floating plant, the leaves having large swollen petioles; erect panicles of blue flowers; should be kept within bounds, as by itself, it will fill the pond.

Trapa natans. (Onagraceae). Chinese Water Chestnut. Dainty with variegated foliage which forms a loose rosette as it floats on water. Nuts are well known as article of food.

Plants suited for planting near margin of water:—

Acorus calamus. (Aroideae). Sweet Flag. Tidy growing aromatic plant, bruising of any part causing a pleasant scent. Propagated by seed or division of rhizomes.

Erect leaves, which are striped golden yellow in the variegated variety. Height, $\frac{3}{4}$ metre.

Alisma. (Alismaceae). Water Plantain. Long, upright, arrow-headed leaves; striking.

Cyperus alternifolius, and its variegated variety. *Cyperus papyrus*. See pages 342-43. Both the above *Cyperus* species are usefully grown in a tub and left in water or planted in the shallow margin.

Nipa frutescans. Water Palm. See page 386.

Sagittaria sagittaeifolia. (Alismaceae). Arrow-head. Large sagittate leaves. Flowers white, deepening to pale blue at the base of the perianth. A good oxygenator and hence useful in a pond in which fish are bred. Grows in $\frac{1}{4}$ - $\frac{1}{2}$ metre of water.

Plants suited for marginal planting and for the wet bank of the pond:—

Areca lutescens; *Cardulovica palmata*; *Cyclanthus*; *Raphis flabelliformis*; *Hedychium*; *Iris* in variety; *Alpinia*; *Costus speciosus*; *Alocasias*; *Schizocasia Portei*; *Colocasias*; *Xanthosoma*; *Arundo donax variegata*; *Arundo metallica*; *Crinum aquaticum*; *Pancratium*; Ferns like *Osmunda regalis*, *Asplenium*, *Angiopteris*, *Acrostichum*, *Marsilea* etc.; Ornamental Grasses.

Moisture-loving trees and plants for the back-ground:—
Bamboo; *Tamarix*; *Salix*; *Barringtonia acutangula*; *Acacia Farnesiana*.

CHAPTER XXIX

THE KITCHEN GARDEN

Selection of site. Lay out etc. Select a well drained plot of ground, open but sheltered against winds, free from the shade and roots of large trees. Let it be located at the back of the bungalow or house or in the orchard when the trees are still young. Screen it from the ornamental part of the garden with a tall hedge. Slope the ground gently from the well to the finishing end and divide it into convenient square or rectangular plots, say 6 to 10 metres. across, by laying permanent paths. Sub-divide these plots into smaller ones, about 1 metre across, by narrow paths, to facilitate weeding etc., without trampling. Arrange the water channel and its distributaries in such a manner that the water flows in them by gravitation smoothly without scouring. To save water which percolates through the soil under the channels while irrigating, build the channel and its branches in brick and mortar or embed semi-circular tiles in them throughout, cemented on to each other.

Improvement of soil. One has got to take the soil as it is, and improve it in the ways suggested in Chapter III. Rich well drained friable loamy soil is the best for growing vegetables. It should be free from alkaline salts as sodium chloride and sodium carbonate and the water too should be free from them. Sandy loam is best suited for raising root crops. Light soils produce early, and heavy soils, late crops. Cultivation to a depth of about $\frac{1}{2}$ metre would do for most kinds of vegetables.

Rotation of crops. Generally, plants belonging to the same natural family, and particularly plants of the same kind or variety, require for their growth certain food elements, which they take from the soil, leaving it poorer in those elements. Successive growing of the same vegetable or kinds of vegetables on the same ground would therefore tend to make the soil "vegetable sick" for those particular vegetables. Thus, to get the best results, never grow the

same kinds of vegetables, such for instance as, Cauliflower, Cabbage, and Knol Kohl or Tomato, Brinjal and Capsicum, in the same plot, following each other. Further, each kind of crop leaves very often a toxin in the soil which affects the growing of that crop, if repeated without rotation. Rotation thus is beneficial for retaining the fertility of soil. Rotation also helps to keep down insect pests and diseases to which particular plants are subjects as they would be 'starved' by an intervening crop on which they do not feed. Alternation of crops has also a wholesome effect on the mechanical condition or the tilth of the soil, some kinds of plants being more deep-rooted than others and requiring deeper preparation of the land than others. Plants which are deep-rooted as the carrot, beet and radish should alternate with shallow-rooted kinds as the bean. In a good scheme for rotation, root vegetables as Carrot and Radish are succeeded by Leguminous crops as the Bean and Pea with advantage. They collect and store nitrogen in the soil which is needed by leafy vegetables such as Cabbage, Lettuce and Leek, which follow them.

Fallowing. Land in which vegetables are grown should be fallowed, that is, kept vacant, for a few months in the year, as continuous cropping exhausts the soil. The time to fallow land is the summer in dry and hot countries. The ground should be worked deep and all lumps of earth left unbroken. Exposure of soil to the air has a very desirable effect in sweetening it, in helping it to maintain a stock of nitrogen, and in making the fertilizing constituents of the soil available to the plants grown in the next season. Constant ploughing and fallowing are useful also in exposing the pupae of insect pests to the heat of the sun by which they get killed or picked by insectivorous birds as minas, crows, etc. Spores of fungus pests and other organisms inimical to nitrogen fixing bacteria are also killed.

European and Country Vegetables. Vegetables may be grouped to fall under two heads:—(A) The European or the temperate and sub-tropical vegetables and (B) the Country or the tropical vegetables. The former do best in the cool moist climate of the hill stations and are generally suited for

elevations of above 750 metres, though some of them may be grown with a certain degree of success at low elevations including sea-level in the cold season. Hence, they are also known as cold-season vegetables. The latter are best suited for low and intermediate elevations and are grown in the hot and rainy seasons in the plains and hence they are known also as summer season vegetables.

Imported and acclimatised seeds. The European or cold season vegetables are best raised from imported seeds. Most of them deteriorate by acclimatization and several of them do not seed at all in this country except in Kashmir and Baluchistan, where they are raised now. Of those that may be acclimatised successfully are the bean, pea, lettuce, onion, radish, cress, tomato, Indian corn, etc. Acclimatised seeds of cauliflower give satisfactory results at low elevations. Country vegetables are all raised from local seeds.

Time for sowing. The cold season vegetables are sown from August to December in the plains and February to June on the hills. The time for sowing hot season vegetables is from January to April in the plains and intermediate elevations. Such of those varieties and kinds of European vegetables which take a long time to mature should be sown sufficiently early in the season. In places where the winter or the cold season is very short, only early maturing varieties should be grown, as for instance, the short horn or the globe varieties of root crops as Carrot in preference to the long rooted-kinds. To save disappointment, seeds should be obtained in time from reliable firms and sown in small quantities at intervals of a few days. No sowing should be done when the soil is wet or saturated with moisture. It should be postponed till it gets moderately dry—when a handful of it would crumble into powder, when pressed in the hand and released. Peas, Beans and such other seeds would rot away, if rain sets in for two or three days continuously after sowing.

Modes of growing Vegetables. Refer to pages 65-71 for instructions regarding sowing of seeds and the care to be taken of seedlings.

Not all vegetables are grown in the same way. The following are some of the chief methods of growing different kinds:—

(M. 1) Greens like *Amaranthus* (Vern. Keerai, Chauli bagi), Fenugreek (Vern. Venthiakeerai) are grown by broadcasting the seeds in well manured level beds measuring about $\frac{1}{2}$ to 1 metre separated by small bunds or ridges of earth. The seeds are covered by 0.65 cms. depth of fine soil mixed with old spent manure. Or, the soil may be gently raked to a depth of about 1.25 cms. or stirred with the fingers and pressed down. Watering is first done, best with the rose of a watering can. If it is done by irrigation, care is to be taken that the water slowly wets the soil and does not rapidly run into beds disturbing the soil covering the seeds. After the seeds have sprouted and the seedlings have taken firm root in the soil, the beds may be irrigated.

(M. 2) Seeds of some kinds like Carrot, Radish broadcast thinly in beds prepared as in M. 1, the seeds falling about 1.25 cms. apart and then covered with soft soil. When the seedlings are large enough to be handled, thinning is done by pulling out crowding seedlings, leaving the remaining ones to stand at desired distances apart—10 to 15 cms. or more—for satisfactory growth of individual plants.

A better plan would be to sow such seeds in shallow drills drawn 10 cms. or more apart and cover the seeds with fine soil. Thinning would then be confined to one direction only and much seed would thus be saved.

(M. 3) Seeds of some kinds as the dwarf French Beans are pressed into the soil about 1.25 cms. deep in parallel furrows. 22 cms. to 35 cms. apart, a number of such furrows adjoining each other and forming one block or large bed. Water is led into the furrows. Thining is done to desired distances apart in the furrows. After the plants have grown to a desired height, earth is drawn into the furrows covering the stems of the plants, the earth moved leaving two furrows or sub-channels for irrigation on either side of a row of plants which are now supported well by the earth around them.

(M. 4) The seeds of such kinds as Okra, Bush Lima, are sown in furrows standing farther apart than in M. 3 and the rows are separated by a length of 50 cms. or more, as these plants require more room for growth.

(M. 5) Seeds of such kinds as Peas, Runner Beans are sown in rows farther apart than in M. 4 as far apart as $\frac{1}{2}$ to 1— and metre the rows of plants are provided with supports to climb on, a trellis of poles or split bamboos placed crisscrosswise.

(M. 6) Seeds of Pumpkins, Cucumbers, and such trailing plants are sown in holes or pits, made far apart — $1\frac{1}{2}$ metres or more—and filled with richly manured soil. The pits are watered by hand or by irrigation. More seeds than required, about five, are usually put down and only one or two or three strong plants are retained for growing and the rest pulled out. As the plants grow, they are allowed to trail along the ground and bear fruits. The fruits are often raised and placed on pads of straw and not allowed to touch the ground lest they should get damaged and rot.

Some trailing plants as Bitter Gourd of the long fruiting type are grown as above in pits and the plants in each pit are trained on supports for superior fruits.

Some others like the Snake Gourd are grown on pandals erected for the purpose over the pits, the plants being taken up to the pandal by allowing them first to grow against supports. For convenience, such kinds as Double Beans, Indian Runner Beans which spread widely, are also grown on pandals. So also, Chow Chow, ripe fruits with a sprout in each of them, being put down, one in each pit.

(M. 7) In all the above methods, the seeds were sown *in situ*, in places where the plants were to yield or bear fruit. There are several kinds of vegetables, such as the Cabbage, Cauliflower, Brinjal, Tomato which have first to be sown thinly in nursery beds. The seedlings have to be transplanted once or twice before they are shifted to their permanent places. The stocky seedlings are planted in furrows or rows at definite distances apart. The plants are earthed up later, if necessary, as growth progresses.

Manuring. For suggestions on manuring, refer to Chapter IV generally. Cattle manure in a well decomposed state is used for growing vegetables. Horse manure may be used with greater benefit in connection with clayey soils. Oil-cakes give very good results. So also small doses of night-soil manure allowed to decompose in a pit for a year with alternate layers of earth. In advanced countries, sewage either in crude state or after decomposition in septic tanks is used as manure. No harm can arise by its use. Unfortunately, it is wasted in many of our cities. In conjunction with organic manure, the following mixture of artificial manures may be found beneficial for growing vegetables for exhibition. Make a mixture in the proportion of 2.2 kg. of super phosphate, 3 kg. of ammonium sulphate, and 1 kg. of potassium sulphate. For making liquid manure, 2.2 kg. of this mixture should be dissolved in 45 litres of water. About 4 hundred-weights of this mixture may be used for an acre of land. Manuring should be done intelligently according to the needs of the particular plants. Vegetable crops as Cabbage, Lettuce, etc., which are grown for their leaf should have a liberal supply of nitrogenous manure. Potash is useful for root crops, phosphorus for flower and pod producing crops. Fresh manure should be avoided in growing root crops. They can manage with the residual effect of manuring for a previous shallow rooted crop. Too much feeding would result however in coarse crops, especially those of roots, and in rotting and splitting, as in Cabbage and Knol-khol. Do not feed strongly any vegetable grown for leaf till after about a month after germination when it would be about half grown. Manure root-crops when the roots are just thickening. Manure the crops for flowers when the flower-buds are forming. Liquid manure may be supplied with advantage by rubbing up fresh cow-dung between the hands into the water at the head of the channel while irrigating.

Watering. Kitchen garden plants should be watered regularly and copiously. Supply by irrigation is more desirable than hand-watering. The plants should not receive any check in growth for want of water. In the case of

vegetable crops, more harm is done by under watering than overwatering. For instance if the soil is not kept moist throughout, crops of Cabbage and Cauliflower fail.

Cultivation. Stir the soil now and then to keep down weeds. Attend to operations as earthing up, blanching, staking, thinning, etc., where they may be called for. *Earthing* up consists in drawing the soil towards the base of the plant, affording shelter to the roots and inducing them to grow better. This is done in the case of the Bean, Pea, Cabbage etc. *Blanching* is done in the case of such vegetables as Celery, Leek, Endive. Asparagus to make them tender and to remove the green colouring matter which imparts a certain bitterness to them. Blanching is done either by earthing-up or covering the shoots with leaves or sand, or by covering them with a pot or similar vessel cutting off sunlight to the plant, by tying up the leaves over the centre of the plant.

Growing vegetables for Exhibition. Dig a trench $\frac{1}{2}$ metre wide and $\frac{3}{4}$ metre deep. Fill the bottom to a depth of about 15 cms. with well rotten manure and the top $\frac{1}{2}$ metre with rich loam which should be mixed liberally with well decomposed manure. Plant seedlings farther apart than the normal in the beds. The roots are attracted by the manure at the bottom and thus a large root system is simulated. This results in its turn in a good shoot system of the plants. Handsome vigorous plants are produced bearing large-sized fruits or pods or leaves as the case may be, fit for exhibition. Supply liquid manure as recommended on pages 48 to 50. Thin the fruits judiciously, keeping a few only on each shoot.

Trees supplying vegetables. Green **Papayas** are cooked and eaten like Pumpkins. One or two trees planted in the back-yard on the fringe of the vegetable plot or by the compound wall would supply fruits throughout the year. The **Jack** is a familiar tree in S. Indian gardens of large dimensions. The unripe fruits make a good vegetable and the ripe ones are greatly relished. The **Bread Fruit Tree**, belonging to the same family as the Jack supplies a vegetable liked by many. It requires a tropical climate and a large supply of water. It is therefore planted at the back of the house where the

water from the bath room is utilised without being wasted, for growing it as in the case of **Plantains**. The variety, of plantain called "Mathuranga ; Mondan" is the most favoured. The variety, called in Malabar 'Nendran' is useful as a vegetable for making chips. **Agati** (*Sesbania grandiflora*), **Curry-leaf** (*Murraya Koenigi*), and **Drumstick** (*Moringa pterygosperma*) are three useful trees which find a place in almost all S. Indian gardens. The Agati is easily raised from seed, quickly grows to a height of 5 to 7 metres, has a shallow root system and is sparsely branched and so, does not appreciably affect the growth of other plants near it. It is therefore planted, very often, far apart in the vegetable plot, for its light shade. It is suitable for planting along the boundary fence. The large white flowers with fleshy petals are used for curry or fried with butter. Tender leaves are used as greens. There is a red flowered variety which has an ornamental value, besides being useful. The Drumstick (Tamil. Murungai ; Can. Nugge ; H. Sonjna) is a brittle tree, 5-6 metres high, easily grown from seed or from cuttings, 1 metre long, put down *in situ*. The leaves and flowers, rich in vitamin content are used for curry. The tender pods are cut up into short lengths and used in soups or 'sambar'. The roots are a good substitute for Horse-radish and the tree is therefore called the Horse-Radish Tree. The Curry-Leaf (T. 'Karivembu'; Can. 'Karibevu') tree is a small one belonging to the Orange family. The pungent aromatic leaves are very rich in carotene content and used for flavouring and for 'chutnies'. The tree is easily raised from seed, prefers a light rich soil and a fairly dry situation.

(A) TEMPERATE AND SUB-TROPICAL VEGETABLES

The following are the more important cold season or 'English' vegetables. The common name of each vegetable appears in bold type ; in brackets, its botanical name in italics and the family to which it belongs. Vernacular names are given wherever possible.

Artichoke, Globe. (*Cynara scolymus*. Compositae).
(Vern. 'Hatichuk').

A perennial plant on the hills, grown as an annual at lower elevations. Its globular immature flower-heads are delicious when boiled. Sow, plains, July to October, and hills, March to May, in well raised nursery beds. As acclimatised seeds degenerate in two to three years, it is preferable to sow freshly imported seeds. Germination is slow and takes 7 to 12 days. Plants may be raised from suckers or offsets from old plants but seedlings give better results. Rich soil—heavily manured, well drained sandy loam—and plenty of water essential. When seedlings are 10-15 cms. high, they are carefully lifted and planted $\frac{3}{4}$ metre apart in beds made $\frac{1}{2}$ metre wide and deep and liberally supplied with cattle manure. The distance apart between two rows of beds may be 1 metre. Keep the ground free from weeds. When the buds are forming, feed with cow dung liquid manure, once a week. Heads take about 10 months to form after planting and should be gathered before seeds are formed. To get a regular supply, cut back the old stems to ground level, when heads are collected. Generally unsuited for elevations below 900 metres.

Varieties: Early Purple Globe and Green Globe are good.

Artichoke Jerusalem. (*Helianthus tuberosus*. Compositae) (Vern. 'Hatichuk').

Hardy perennial, grown for its tubers. Used like potato and also for making sauces, flavouring and thickening soups. Thrives best at elevations of 250 to 500 metres and can be grown up to 1,000 metres. Soil should be light and not too rich. Plant tubers, plains, March-May and hills, March-April, 7.5 cms. deep, 40 to 45 cms. apart, in rows $\frac{1}{2}$ to $\frac{3}{4}$ metre apart. Plants grow $\frac{3}{4}$ to 1 metre high. Earth up main stems when 20 to 30 cms. high. Pick off flowers as they appear. Tubers are ready in 4 to 6 months. Too rich a soil and heavy feeding result more in leafy stems than in good sized tubers. As they do not store well, do not lift them till they are required. An acre may produce about 5000 kgs. of tubers. The acclimatised variety is better than imported ones.

Asparagus. (*Asparagus officinalis*. Liliaceae). (Vern. 'Soot Moole', 'Palagras'.)

Perennial grown for is tender delicious culms or shoots. Not quite successful at lower elevations, Not usually grown in home gardens, as too much space is necessary for a fair supply and too long a time is taken. Sowing done April to June on the hills ; and August to September at lower elevations. Drop fresh seeds 2.5 cms. apart in drills 30 cms. apart in nursery beds and cover with 1.25 cms. depth of fine soil. Germination takes place in 15-20 days. Thin out seedlings spacing them 15 cms. apart. When plants are about 20 cms. high, transplant them 45 cms. apart, into the middle of well prepared and richly manured beds, which are $\frac{1}{2}$ metre wide and are worked $\frac{1}{2}$ metre deep. Soil should be rich, friable and well drained. Water liberally immediately after planting and repeat the supply every week. Encourage the plants to throw out as many shoots are possible during the first two years, as then only a good undergrowth of roots is made. Top-dress the bed every year, during December-January with well decomposed horse manure and a sprinkling of common salt and stir gently with a fork. Give copious watering. In March, new shoots appear. Cut the best of these for use and allow the weak ones to grow. The plants reach their maturity in their 4th or 5th year and last for about 10 more years. Bleach the shoots with sand or light soil and cut them only with a very sharp knife as low down as possible. The blanched shoots are silvery-white in colour. Improper blanching will produce green shoots of bitter taste. Cut shoots right up to October and again dig in manure in winter ; applying $\frac{1}{2}$ to 1 kg. of salt for every sq. metre. Repeat this every year.

Varieties: Mary Washington is very good. Also Palmetto.

Beans, Broad. (*Vicia Faba*. Leguminosae). Vern. 'Bakla Sem'.

There are two types:—(1) The Windsor or Broad-podded varieties and (2) The Long-podded varieties. They may be either white or green seeded. The seeds, either green or dry, are cooked and eaten. Generally, Broad Beans cannot be successfully cultivated in the plains. At lower elevations, the Long-podded variety may be grown with some satisfaction with good cultivation. The Windsor type, which is better

flavoured, is best suited for hill stations. Sow seeds 5 to 7.50 cms. deep, 20 cms. apart in double rows, that is, in two drills which are spaced 25 cms. apart. Allow a space of $\frac{1}{2}$ to $\frac{3}{4}$ metre between each pair of double drills. Sow, hills, March-May, and lower elevations, October-November. If the soil is dry, soak the seeds in warm water for a few hours before sowing to ensure quick germination. Soil manured for a previous crop is preferred. 2.2 kg. of seed is required for a double row, 12 metres long. When plants are 25 cms. high, earth up the stems and support with sticks, if windy. Remove basal suckers so that each plant is confined to a single stem. Cut off the tops of the plants after flower clusters are formed. This helps the pods to set and develop early and checks attacks from black aphid. As soon as the insects are observed, spray with soap solution with tobacco decoction. Press back the keel of every flower to ensure pollination. Crop, ready in about 3 months.

Beans, French or Kidney. (*Phaseolus vulgaris*. Leguminosae). Vern. 'Hurulikayi'; 'Kollukkai'; 'Sem'.

A very popular vegetable, easily and quickly grown. Sensitive to wet and cold and hence the very cold winter months and the rainy season, where rains are heavy, should be avoided. Requires some shade in hot places in the hot season. Any good soil, worked to a depth 20 to 25 cms. decomposed manure will do. As the cotyledons of the seed are pushed up the ground, it is desirable that the soil should be loose and mellow and not liable to cake after watering.

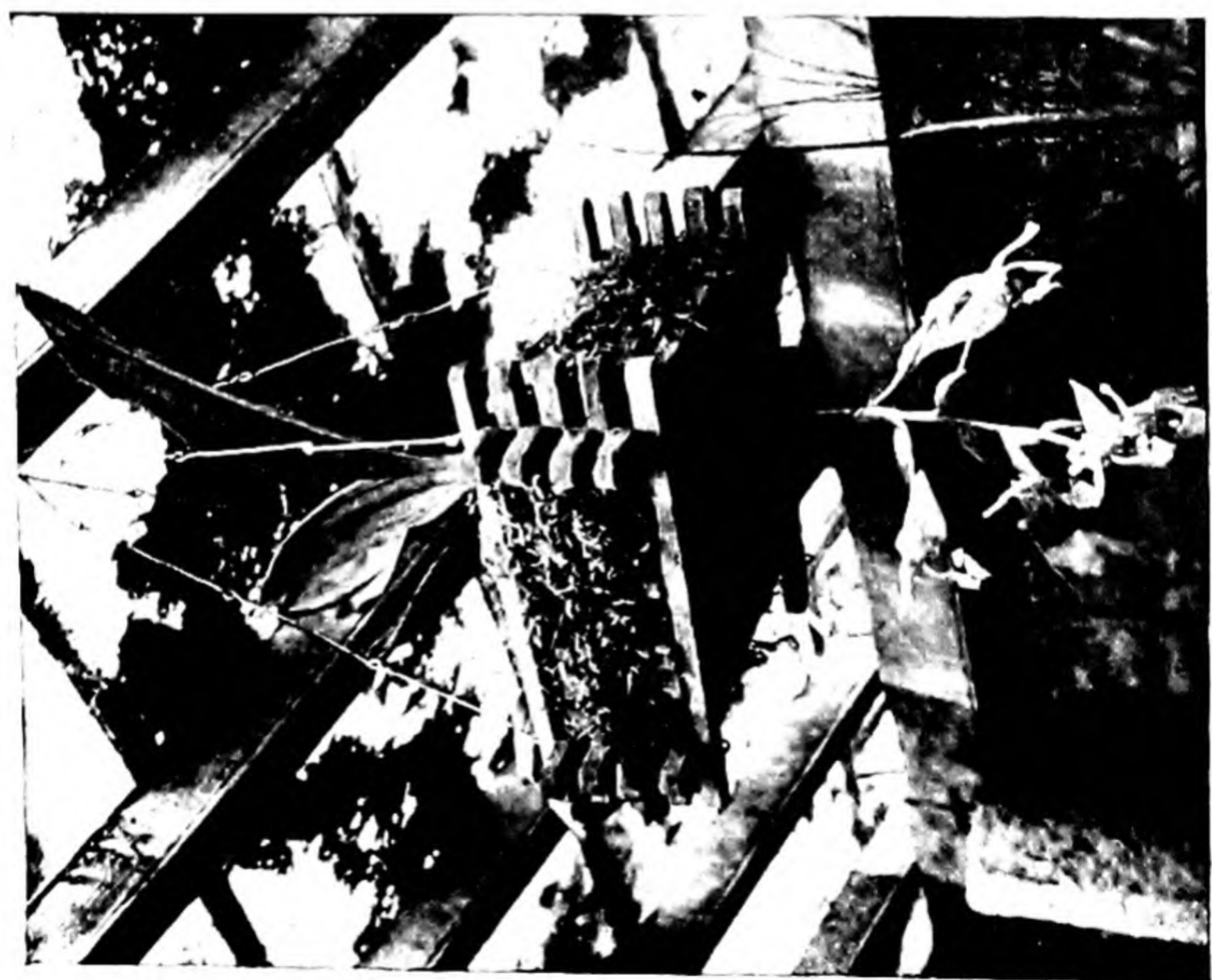
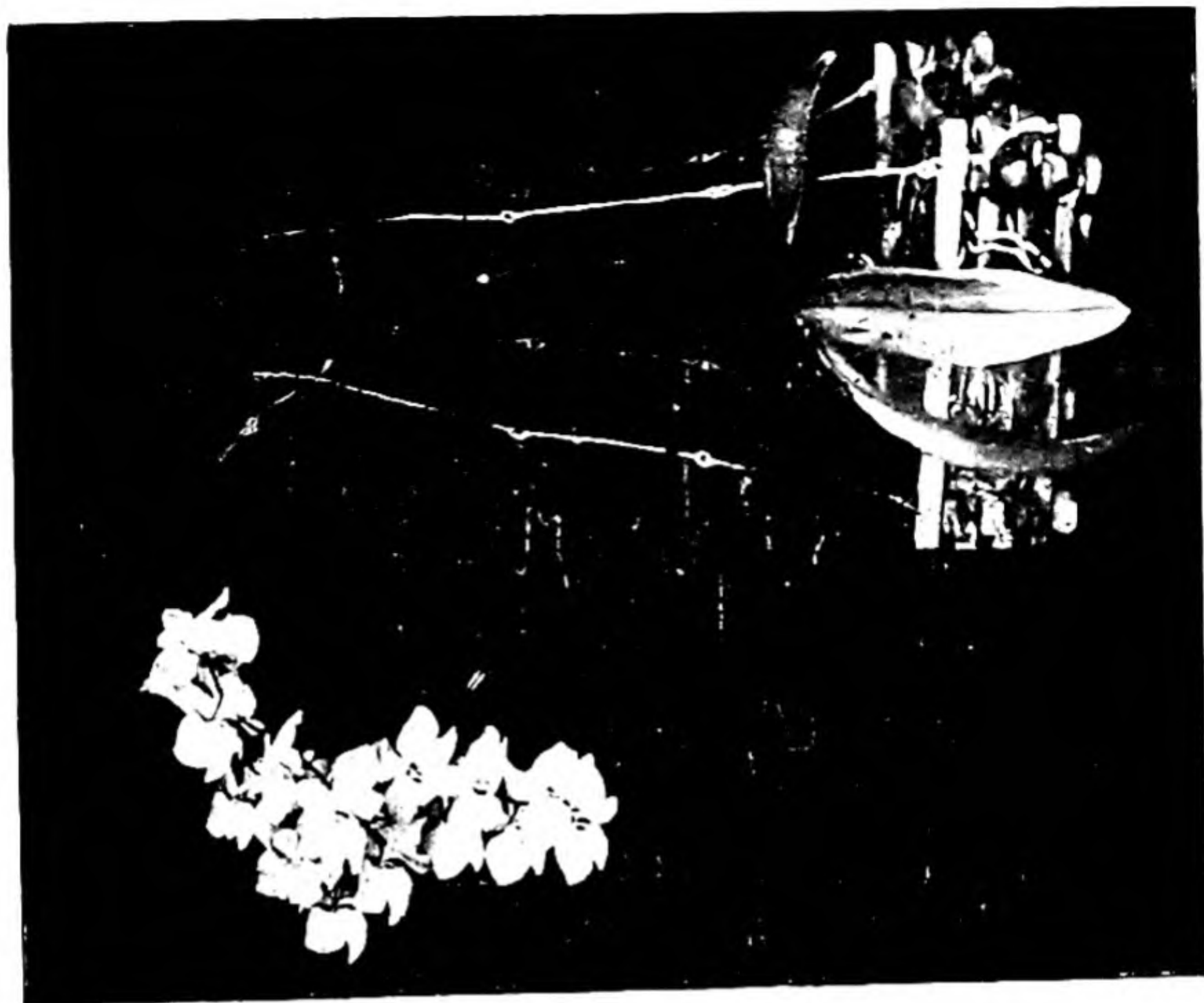
There are two types of French Beans:—(1) The Bush or the Dwarf kind and (2) the Climbing or the Runner or the Pole kind. The latter is more prolific and has a longer season of yield but is more delicate than the former. In both, there are the green and the wax-podded varieties. The wax-podded varieties which are cream or light yellow coloured are better relished but are more delicate to grow.

French Beans are best sown in the plains from August to October and on the hills from March to July. Sow the dwarf kinds 12 to 15 cms. apart, 5 cms. deep, in rows 45 cms. apart. 2 kg. of seeds would sow a row of about 35 metres. About 200 kg. may be required for an acre. The seeds break the

ground in 6 days. When the plants have grown to 15 cms., draw up the earth against the stems. Sow seeds of the Runner kind in double lines, 25 cms. apart, with a distance of 1 metre between each pair of double rows. Provide bushy stakes, 1.50 to 2 metres high, for the plants to climb on. Put them on each side of the double lines in a sloping manner, so that they meet at the top. If bushy stakes are not available, drive strong stakes or poles, at each end of a double row and stretch two wires over them, one about 15 cms. from the ground and the other 1.5 metres above it. Then, connect the two by tying cheap thread, spacing the threads 30 cms. apart forming a sort of trellis, for the vines to run on. Dwarf kinds are ready in 42 to 55 days, and the runner kinds in 60 to 75 days. Gather the beans when they are still tender, when the pods snap cleanly between the fingers. The plants get exhausted and die soon and do not bear continuously, if the pods are allowed to mature. Three or four pickings should be possible before the plants finish.

Varieties: Several. 'Stringless' ones recommended for home garden. Select varieties are: Dwarf kinds, Stringless Green pod; Tender Green; Sure crop Stringless Wax; Idaho Refugee. Asgrow Valentine, Contender, Climbing kinds:—Kentucky Wonder; Golden Cluster Wax; Earliest of all.

Bean, Lima. (*Phaseolus lunatus*. Leguminosae). Called also the Butter or Double Bean. Seeds, which are mostly white and speckled in some varieties, are used and not the pods. The leaves and beans contain hydrocyanic acid which is a poison and livestock should not be fed upon them. Boiling eliminates the poison and renders the beans a good food. They are farinaceous and possess a fine flavour. There are two types, the bushy and the climbing. The former is grown like the French Bean, sowing the seeds 15 cms. apart in drills $\frac{1}{2}$ – $\frac{3}{4}$ metre apart dropping the seeds edgewise and downwards. The plants are thinned out to stand 25 cms. apart in the rows. They grow to about 45 cms. and have a spread of $\frac{1}{2}$ metre and more. The long blossom shoots should not be disturbed. Grow the climbing type as the Runner French Bean. Or make pits, 1 $\frac{1}{4}$ metres apart and about $\frac{1}{2}$ metre wide and fill them up with soft mellow soil. Put down





IRIS



ORCHID, SPATHOGLOTTIS

6 seeds in each pit and around a strong rough pole, $1\frac{1}{2}$ metres high in the middle of the pit. Allow only three of the strongest plants to remain and climb up each pole. The common variety with the seeds speckled red is vigorous growing and is often grown over a small pandal. The Bush type is about 2 weeks earlier than the climbing type and is ready in 70-75 days. Refusal to set pods is due to want of potash. Spray nicotine and soap solution as remedy against aphids.

Varieties.— Bush, Burpee's Fordhook and Improved Bush Lima; Pole, King of the Garden, Burpee's Giant Podded and the common extensively grown market variety, with white red speckled seeds.

Beet, Beet-root (*Beta vulgaris*. Chenopodiaceae). Vern. 'Chukandar'.

A good root vegetable for salads. May be grown at all elevations. Sandy loam is best suited. Dig deep and dig in liberally well decomposed manure, burying it well under. Sow, plains, August-November, hills, March-May. Sow 2.5 to 4 cms. deep, 7 to 10 cms. apart, in drills 40 cms. apart. Press down the soil after sowing. Each corky ball of seed is really a fruit containing many seeds and therefore the seeds germinate in clusters which should be thinned to one plant. Thin out to 15 cms. in the drills and transplant the plants removed. But, the best roots are formed only when the plants are not disturbed. Lift the roots with a fork, when they are 7.50 cms. in diameter, without damaging them. Wash soil off and twist off the leaves and not cut them, especially near the crown, as bleeding would spoil the colour for the table and cause all the goodness of the vegetable to run out. Ready in 10-13 weeks. 30 gms. will sow a drill about 25 metres long; may be required for an acre.

Varieties.—Crimson Globe; Crosby's Egyptian: Detroit Dark Red; Red Ball.

Beet Spinach. Chard. Swiss Chard. (*Beta vulgaris* var. *Cicla*. Chenopodiaceae).

A beet in which the foliage part makes greatest growth and not the root. The leaf blades are used like spinach and the thick leaf-stalks cooked like Celery. Grown like Beet, with more space between any two plants. The leaves

are cut for use before they turn yellow with a sharp knife at the base of the leaf-stalks. There are several varieties, maturing from 50 to 70 days.

Brussels Sprouts. (*Brassica oleracea gemmifera*. Cruciferae). Vern. 'Chote Kobe'.

Called by some Bud-bearing Cabbage, The plant has an unbranched stem bearing Cabbage-like rounded leaves, in the axils of which are borne the buds or sprouts, which develop 2.5 to 4 metres in diameter and appear like miniature cabbages. They are more delicately flavoured than the Cabbage. Brussels Sprouts thrives to greatest perfection on hill stations and can be grown with fair success in the cold season at medium elevations. It is grown like Cabbage, needs very rich soil and plentiful supply of water during the entire period of its growth. Sow seeds thinly, August-September, at mid elevations, and March-May at hill stations. Transplant seedlings 75 to 90 cms. apart, with a good ball of earth adhering to the roots. When about 22 cms. high, earth up lightly and firm the soil. 50 to 100 sprouts may be produced on a plant. As the sprouts develop, the lower leaves turn yellow and should be removed. This induces regular sprouting and facilitates to snap off the buds. The lowest sprouts are collected first and picking is done successively from below upwards. 30 gms. will produce 1200-1500 plants. Subject to same pests as the Cabbage.

Cabbage. (*Brassica oleracea, variety capitata*. Cruciferae). Vern. 'Kobee'; 'Muttai-kos'; 'Kosu'.

A very popular English vegetable. There are several well marked varieties, differing in size, shape and colour of the conglomerated leaves, called heads. The following are distinct types of Cabbage:—(1) The Conical or pointed kind, called the sugar-loaf varieties from their heads, is an early one. (2) The Drum-head or flat variety is unequalled by any in flavour, size and hardiness. It is the chief market variety. (3) The Red variety is used for pickling. It does not stand heat well and (4) The Savoy variety has crimped leaves and it is better suited for lower elevations than other kinds.

Cabbages form good heads only about 625 metres above the sea. At lower elevations, the early varieties as Golden Acre which form small heads in 2-2½ months may be grown in the cold season. Rich sandy loam required. The soil can hardly be too rich for Cabbage. Dig in plenty of sheep or goat dung, if available. Decomposed night soil or sewage gives excellent results. Sow, plains, August-September, and hills, March-May. 30 gms. provides about 1500 plants. Raise them in well prepared seed beds, sowing seeds not more than 1.25 cms. deep. As soon as they have made their first true leaves, transplant them to well raised beds 15 cms. apart, setting them down to the level of the first true leaves. When they have made six leaves, plant them out 35 to 45 cms. apart in rows 50 cms. apart. The planting distance should vary with the variety grown, the larger growing Drumhead, requiring to be planted even 50 cms. each way. Lift the seedlings carefully with as much earth attached to the roots as possible, and transplant them as quickly as possible, or they suffer check in growth. Earth up plants when about 20 cms. high. Keep free from weeds. Ready in 80-125 days. The head is cut when it has reached maximum solidity.

Dry weather is responsible for aphid attacks. Spraying water on the plants will greatly help to create a humid atmosphere round the plant. Handfuls of water dashed against the plants on the underside while irrigating reduce the damage from aphid. Rich feeding and washing plants well with soap solution will rid them of these insects. Spraying with tobacco decoction as soon as aphid are observed is necessary to save the crop. The cabbage leaf-eating green caterpillars should be eradicated before the heads are formed by spraying tobacco and soft soap solution. Cabbage is sometimes subject to the club-root fungus, which produces large nodules on the roots, as a result of which the leaves turn yellow and the plant dies. An application of lime dug into the ground disinfects the soil. But, Cabbage should not be grown in the infected plot for a period of 2 years.

Varieties.—All Head Early; Sure Head; Golden Acre; Pride of India; Copenhagen Market; Large Flat Dutch; Large Late

Drumhead; Savoy Perfection Drumhead; Red Mammoth Rock; Marion Market; Premium Flat Dutch.

Carrot. (*Daucus carota*. Umbelliferae). Vern. 'Gajer'; 'Gaju Gedde'.

Popular root vegetable. Several varieties, differing in shape and length—short, intermediate and long rooted. All thrive in sandy loam, richly manured for a previous crop. Soil to be kept loose to a depth of 45 cms. for growing longer rooted sorts. Fresh manure in contact with the roots makes them course and induces 'forking'. Short and intermediate rooted kinds are suited for heavier soils. About 2.25 kg. of seeds required for an acre or 25 gms. for a row about 25 metres. Sow, plains, September-November, hills February-May. Broadcast in beds and thin out to stand 12.5 to 25 cms. apart. Better still, sow 1.25 cms. deep in drills, 25 to 30 cms. apart. Germination takes about a fortnight. Keep off ants which are fond of the seeds. Ready in 70 to 90 days. Pull the carrots for use, when the soil is moist; otherwise, the foliage comes away in the hand.

Varieties.—Danver's Half Long; Nante's Half Long; Imperator; Long Orange; Chateney Red Cored; Chateney Half Long.

Cauliflower. (*Brassica oleracea* var. *botrytis cauliflora*. Cruciferae). Vern. 'Phool Kobe'; 'Poo Kos'; 'Hoo Kosu'.

Belongs to the same family as the Cabbage and is grown like it. Like the Cabbage, it can be grown only in well tilled, rich, well watered soil. There are several varieties, which may be classed as early, Medium and Late, taking 90 to 120 days to mature. The part used is the dense flower head, which is snow white in colour. Best suited for places above 625 metres. Imported seeds give the best results, in the absence of which acclimatised seeds from North India may be used with a fair degree of success. For lower elevations, only the Early varieties are chosen. Sow, plains, July-August, hills, February-April. 30 gms. of seeds gives about 3,000 plants. Sow seeds in nursery beds and transplant 10 cms. apart in beds of light rich soil. Again, transplant when 4 to 6 leaves are formed into permanent places 40 to 50 cms. apart, in rows 60 cms. apart. Do not damage the roots while transplanting.

Make deep holes for planting without turning up the tap roots. Keep free from weeds and earth up when plants are growing. Soon after the flower heads are 5 cms. in diameter, shade them or draw the leaves over them and tie them to prevent the heads from browning. Subject to the same pests as Cabbage.

Varieties.—Early Snow Ball; Super Snow Ball; Main Crop Pusa; Best Early.

Celery. (*Apium graveolens.* Umbelliferae). Vern. 'Salary'; 'Kurass'.

Grown for its long fleshy leaf-stalks, which when blanched to a crisp and tender condition, form a very wholesome salad. Unblanched, in the green stage, the leaf-stalks and leaves are excellent for flavouring. Richly manured soil, plenty of moisture and good drainage are primary essentials for success. Disease-free imported seeds should be secured. Acclimatised seeds, very often, produce plants only fit for flavouring. 30 gms. will give about 5,000 plants. Sow, plains. August-October, and hills, February to end of April. Seeds are small. Sow them in a seed-pan. Germination takes a long time—4 to 6 weeks. When large enough to handle, prick the seedlings 7.5 cms. apart in nursety beds or seed-pans. Protect from rain. Dig trenches north to south, 40 cms. deep, 45 cms. wide and 1 metre apart from centre to centre. Break up the bottom of the trenches and mix up with the soil plenty of well decayed manure. Transplant seedlings, when 10 to 15 cms. high, 25 to 25 cms. apart, into the middle of the trenches. Water liberally. Apply liquid manure once in 10 days when growing. Stir the soil frequently removing weeds and all lateral shoots as they appear. After the plants are about 30 cms. high or are nearly full grown, remove the short outer leaves, and holding the remainder with the hand closely together, draw earth to their base to a depth of 10 to 12.5 cms. Each week, carry the earthing up process higher and higher till the leafy tops are just visible. While the blanching is done, tie the stems and leaves together. Care should be taken not to bury the plants too deep all at one time, as they would rot away. It is safest to slope the soil to the middle of the leaves or the crown of the plants. A circle

of thick brown paper put round the stems before earthing up will prevent rot. The earthing up or blanching, as it is called, is begun 2 to 4 weeks before the plants are required for use. Ready in 5 to 6 months.

Varieties.—Golden Self Blanching ; Golden Plume or Wonderful ; Easy Blanching ; Waring's Dwarf White.

Celeriac. Turnip-rooted Celery. (*Apium graveolens* var. *rapaceum*. Umbelliferae).

Known also as the Knob Celery, it is a variety of Celery, the plants being more dwarf, making a swollen growth, 5 to 8 cms. across, at the base of the leaves. The root has the flavour of Celery and Parsnip and is used cooked or as an ingredient in salads. The leaves are used for flavouring. Grown like Celery up to the final transplanting, which is not done into trenches but into large beds, $1\frac{1}{2}$ to 2 metres wide, 25 to 30 cms. apart in rows 30 cms. apart. Roots ready in about 4 months.

Chow-Chow. Cayote. (*Sechium edule*. Cucurbitaceae). Vern. 'Seeme-Kattirika' ; 'Seeme Badane'.

Robust perennial creeper, grown by planting a germinated fruit, that is, a whole fruit with a bud in it, in a pit, 30 cms. deep and 40 cms. wide, filled with well manured soil. Lead the vine over supports on to a pandal or an arch or over a dwarf tree. Thrives at elevations of 375 metres and upwards. Requires light shade at lower elevations. The fruits are produced four months after planting. They are pear-shaped, pale green or cream-coloured—there being two varieties. Used like Vegetable Marrow. The Yam which is produced underground is also much relished. Green bug and brown scales are common insects pests.

Cress, Curled or Garden. (*Lepidum sativum*. Cruciferae). Vern. 'Halim' ; 'Kochika-elai'.

Quick growing short-lived plant, grown for its leaves, which are used for salads. Can be grown at all elevations all the year round. Sow seeds in shallow drills, or broadcast them in beds, in shade and sprinkle soil over them and keep the soil moist. Ready in 12-15 days.

Cress, Water. (*Nasturtium officinale*. Cruciferae).

A small perennial herb found naturally growing in beds

of small streams or ditches in North West Himalaya region. The leaves have antiscorbutic properties and form a relished salad. Grown from offsets, which are put down 10 cms. apart or from seed. Easily grown in a bed near a water channel where it can be flooded often. The water however should not be allowed to stagnate in the beds.

Endive. (*Chicorinn Endiva*. Compositae). Vern. 'Kurusalad'; 'Bilayati Kansi'.

Annual, grown for its head of leaves, used in salads and other preparations. There are two types, one with broad Lettuce-like leaves and the other with curled leaves. Grown like Lettuce. Sow, plains, September–December, and hills, March–June. Sow in nursery beds. Transplant into well prepared soil very carefully, 30 cms. apart. Water freely. When almost fully grown, in about 2 months, draw the leaves together and tie them up, when free from moisture on them. Thus, the whole plant is covered for blanching. Use a fortnight later.

Knol-Kohl. Kohl-rabi. (*Brassica oleracea var. caulorapa*. Cruciferae). Vern. 'Gant Gobee'; 'Navil Kol Gedde'; 'Nulu Kolu'.

Belongs to the Cabbage family and is grown very much like it. The stem of the plant widens out into a ball-like or ovoid thickening, which is the part used. Combines the flavour of the Cabbage and the Turnip. Resists heat much better than allied members and can be grown successfully at lower elevations too. Sow seeds in drills 30 cms. apart and thin out seedlings 20 to 25 cms. apart, transplanting the seedlings removed. Supply liquid manure once a fortnight, or the stems become rough and fibrous. Best for use, when they are of the size of a tennis ball. The stems become fibrous and woody and therefore unfit to eat in course of time. Sow, plains, August–November, and hills, February–May. Ready in 2½–3 months.

Varieties.—Green and Purple-coloured varieties. King of the market, Early White Viennia, Early Purple Viennia.

Leek. (*Allium porrum*. Liliaceae) Vern. 'Vilayati Piaz'; 'Kirath'; 'Seeme Vengayam'.

Closely related to the Onion but having flattened instead of tubular leaves. No bulb is formed at the base. The stem is slightly swollen at the base and is continued as a cylinder. It is mildly flavoured and used raw or cooked or for flavouring. Thrives above an elevation of 25 metres. Requires deep very rich soil and constant moisture. Sow seeds, August-September at lower elevations and on hills, February-April. Transplant when 10 cms. high, 15 to 20 cms. apart, in trenches, 20 cms. deep and 22 cms. wide, putting the seedlings deep down in the soil. When they are about two months old and increase in size, draw the rich soil on either side gradually, round the stems. For the stems to swell, trim the tips of the leaves constantly. The most important part of the plant is the underground portion which is white and agreeable, when properly blanched. Water liberally. Apply liquid manure 20 days before pulling. Ready in 4 to 5 months.

Varieties.—Musselburgh, London Flag, American Flag.

Lettuce. (*Lactuca sativa*. Compositae). Vern. 'Salad', 'Kahu'.

Much favoured salad plant. Does best at high elevations but can be grown at all elevations. Can be grown throughout the year, excepting the heaviest rainy season. 30 gams. will give about 3,000 plants. Soil to be light and rich. Sow in shallow drills made 30 cms. apart in well prepared beds. Thin out 20 to 30 cms. apart in the case of Cos and 30 cms. apart in the case of Cabbage kinds. Use the plants removed for transplanting into a separate bed for a later crop. Water freely, not on the plants but round the roots only. Tie up the leaves of the Cos type, for better formation of hearts, when 10-12 leaves are formed. Ready in 45 to 55 days. There are three kinds of Lettuce:—(1) The Cabbage Lettuce, forming Cabbage-like round heads with broad leaves. This kind is ready to pull as soon as the hearts feel solid to the touch. If left too long after the heads are solid, the plants 'bolt', the hearts beginning to push onwards and upwards from the centre, when the quality of the vegetable degenerates. (2) The Cos Lettuce, forming conical heads, with narrow pointed leaves and (3) The

Gathering Lettuce, growing large and loose, the lower leaves being picked for use as they mature, like Spinach.

Varieties.—(1) New York; Imperial; Big Boston. (2) Paris, white. (3) Grand Rapids. Black-seeded Simpson. **Mustard. Garden.** (*Brassica alba*. Cruciferae). Vern.

'Seeme Kaduku'; 'Safed-Rai'.

A white seeded kind of the ordinary black Mustard, which is a well known condiment and flavouring agent. Grown for salad in the same way as Cress. Successive sowings made throughout the year, every ten days. Young plants cut for use, when 3 to 5 cms. high.

Onion. (*Allium sepa*. Liliaceae), Vern. 'Piaz'; 'Ven-gayam'; 'Yeerulli'.

Universally popular both for serving as a separate vegetable or for flavouring salads, raw or cooked vegetables, soups etc. There are several varieties—round or flat in shape, strong or mild in flavour, white or yellow or red-skinned—all, possessing a white flesh. Cool moist weather during the early period of growth and fairly warm dry condition as the bulbs mature, necessary for success. Imported seeds of the special kinds advertised in American and English catalogues secured fresh, as Onion seeds do not long retain their viability, are sown in the hills, from March-June. Acclimatised seeds of the local common Large Red and the Silver-Skin or the Patna variety, sown in September-November give very satisfactory results at lower elevations under favourable treatment. Sunny situation and rich, well manured, well drained, loose soil such as sandy loam, essential.

Prepare level beds, 1 metre by 3 metres digging 22 cms. deep and incorporating wood ashes and well decomposed manure into the soil and removing all stones and trash. Broadcast seeds or sow them in drills made 20 to 30 cms. apart. Cover with about 1.25 cms. of fine soil and press the soil lightly. Germination is slow, taking 2 to 3 weeks. When the plants have grown 7.5 to 10 cms. high, thin them to stand 10 cms. apart, using the thinnings for filling vacant beds. Do not transplant too deep or the bulbs do not develop. Keep free from weeds. Do not cultivate deep as roots are on the surface and would get damaged. Feed with liquid

manure. When the bulbs reach maturity and the tips of the leaves turn yellow, bend down the tops and lay them flat to hasten ripening of the bulbs. Water sparingly after this. 15 gms. of seed will sow a bed. 7 to 8 kg. may be required for an acre.

Onions are also grown from dry sets or small bulbs, which are sold as such. From sets, they mature earlier and usually attain larger size. Therefore, sets are often preferred to seeds. Press the sets lightly into furrows 2.5 cms. deep, 10-15 cms. apart. Let the distance between the furrows be 30 cms. in the beds.

For raising seeds, select well shaped large bulbs. Slice off clean the top third of the bulbs, which stimulates them to produce vigorous leaves and strong flower shoots. Plant them in the beds 45 cms. apart.

Varieties.—Sweet Spanish; Ebenezer; Yellow Globe Danvers; Prize Taker; South Port Yellow Globe; Ailsa Craig.

Parsley. See under Seasoning Herbs.

Parsnip. (*Peucedanum sativum*. Umbelliferae). Vern. 'Jazur'; 'Istufeen'.

Unsuited to low elevations. Grows like long Carrots but the plants require greater spacing. Only fresh seeds germinate. 30 gms. will sow a drill 25 metres long. Medium and lower elevations, sow October–November; hills, March–May. Ready in 90 to 120 days.

Peas. (*Pisum sativum*. Leguminosae). Vern. 'Matar'; 'Batani'.

One of the choicest vegetables, amply repaying good cultivation. Peas fall into two groups—the Wrinkle-seeded and the Smooth-seeded. The former is more favoured by home gardeners, being sweeter, finer flavoured and of better quality. The latter is usually more hardy, earlier and of higher yield. From the point of view of time taken to mature, Peas are classified as (1) Early, taking 11–12 weeks (2) Second Early or Early Maincrop, 13–15 weeks (3) Maincrop, 14–16 weeks and (4) Late, more than 16 weeks. Growth is from 30 cms. to 1.5 metres. Early varieties are dwarf growing, 30 to 75 cms. There are innumerable varieties of both groups of Peas in all the classes mentioned

above, advertised in catalogues. All of them thrive well in N. India and at elevations above 625 metres in S. India. Seeds may be acclimatised without degenerating. For plains in S. India, Early and Second Early Smooth-seeded varieties are better suited and they are best grown in cool weather, after the burst of monsoon is over.

Peas are not partial to any particular kind of soil. They prefer a deeply cultivated rich light soil, which has been manured for a previous crop, enriched further with applications of woodashes and bone dust. Undecomposed manure causes more stem and less crop and makes the plants more susceptible to mildew. A dressing of super-phosphate of lime at the rate of 30 gms. is beneficial, as Peas are fond of both phosphorus and calcium.

Too much rain and drought are both unfavourable for Peas. Sow in plains, from October to December, and on hills, from March to end of May and in autumn. 2.2 kg. of seed will sow a double row about 12.5 metres long. After the ground is prepared, make double drills running north and south, 22 to 30 cms. apart. Put the seeds 5 to 10 cms. apart in the drills and cover 2.5 cms. deep. Let the distance between each set of double rows be 4 cms. to 1.5 metres according to the height the variety grows; thus, for dwarf varieties, it may be 45 to 60 cms. and for very tall kinds 1 to 1½ metres. Water after sowing. Sparrows, squirrels, field rats, slugs are all common pests, fond of the seeds or sprouting young plants. The nuisance may be minimised by shaking up the seeds in a cloth soaked with sweet oil and again in another cloth containing red lead, and by keeping watch over the plot till the plants are 7.5 to 10 cms. high. When the plants are 10 to 15 cms. high, remove all weeds, loosen the soil lightly without injuring the roots and draw up the soil to the stems, to enable the plants to get firm hold on the ground. Place bushy sticks on either side of the double rows, meeting at the top as supports for the plants. Wire netting or parallel lines of twine between posts may be employed for the same purpose. Water freely in dry weather. When the pods are well set, pinch off the leading shoots to check the growth of vine and to concentrate the

energy of the plants to form full pods. Gather the pods, not tugging at them but by cutting with a knife, or better still, a pair of scissors. Mildew is the commonest disease, especially in winter.

There is a kind of Peas, called the Mangetout or Edible Podded or Sugar Peas, which takes 75 to 80 days to mature, the pods being used like snap Beans, before the seeds develop.

Potato. (*Solanum tuberosum*. Solanaceae). Vern. 'Alu'. "Urulai Kilangu"; "Alu gedde".

Best varieties can be grown only above 750 metres. Acclimatised kinds can be grown with success at lower elevations. Require well drained sandy loam, well supplied with organic manure, used for a previous crop. The manure should have been applied a long time before planting. A dressing of $\frac{1}{2}$ kg. of a mixture of superphosphate, potassium sulphate, and ammonium sulphate in the proportion of 3:1:1 respectively applied for every $2\frac{1}{2}$ metres of a furrow trench gives best results. A good supply of potash manure is essential for formation of tubers. Select an open situation without shade. Plant, at lower elevations from September–November, and on hills in January–February, and again in July–August. Do not grow Potatoes on the same plot in succession. Keep them in a cool shady place, exposed to light, spreading them on the ground, till the 'eyes' have sprouted to $\frac{1}{4}$ to $\frac{1}{2}$ cms. Cut up the tubers to pieces, such that each piece has on it two sprouts. Dip the cut surfaces in a mixture of slaked lime and ashes, and allow the cuts to dry for a day. Then plant out 10 cms. deep placing the eyes upwards, 40 cms. apart in the plains and 60 cms. apart in the hills. Small tubers planted entire, in place of cut pieces with eyes, do give better results. Water sparingly at first. Sprouts appear above ground in 7 to 10 days. Give a liberal watering when the stems are 15 to 20 cms. high. Then, allow the soil to dry and earth up the stems in ridges about 10 cms. high. Water freely again; 15 days later, hoe between the rows and raise the ridges to 22.5 cms. keeping the soil loose. Too much water rots the tubers. Water sparingly from the time the leaves begin to turn yellowish, which indicates that the tubers are

reaching maturity. Withhold water when the leaves begin to wither. Dig up the crop when the stems die down completely and store the tubers in a cool dry airy place, the bulbs not touching each other. They would do better if soaked in a solution of 2% sulphuric acid. Ready in about 3 months after planting. There are numerous varieties. For planting, select tubers which are free from ring disease. While cutting the tubers, if any diseased tuber is noticed, reject it, and to kill the fungus attaching to the blade, sterilise it by dipping it in a solution of corrosive sublimate or by passing it over the flame of a lighted torch. One diseased tuber will infect an entire field through the irrigation water. Epilachna beetle is a pest of this crop also. Spray a strong insecticide solution at the early stages, to save the crop. Heavy rains cause warts or protrusions on the tubers, which impair their keeping qualities.

Radish. (*Raphanus sativus*. Cruciferae). Vern. 'Moolee'; 'Moolangi'.

Easily grown at all elevations. Select a cool, semi-shady situation in the plains. Light, well cultivated soil, manured liberally is best. Sow seeds in drills, which are 20 to 25 cms. apart. Thin out 12.5 to 20 cms. apart, according to the variety grown. Water freely. A quick growing crop, ready in 20 to 40 days. Sow at intervals of 15 days for crops in succession. Roots become tough and fibrous, if left too long in the soil. Sow, plains, August-January, and hills, March-May.

Varieties.—Several. The country variety with long white roots, called Newar, is the most popular market kind. Jaunpur White and Japanese White is extra long and heavy. Icicle is a half-long good flavoured white variety. Cincinnati is long scarlet. Crimson Globe is globular. French Breakfast is also crimson in colour, small, oval shaped, and excellent for salad. White Giant produces 60 cms. long, 7.5 cms. thick roots.

Spinach. (*Spinacea oleracea*. Chenopodiaceae). Vern. 'Palak Sag'; 'Isfancy', 'Seeme Basale Keerai'.

Stemless annual herb with soft succulent leaves, which when cooked and dressed form an agreeable vegetable. The leaves are rich in vitamins A, B and C and in iron salts. There

are two types, one with triangular leaves and prickly seeded and the other with round leaves and smooth seeded. In the former, the leaves are taken when required and in the latter, the whole plant is taken off. Spinach is a quick-maturing plant sending down a long tap-root and so the bed should be deeply dug and well manured. In the plains, a slightly shaded situation is preferred. Sow, plains. September–November, and hills, February–April. Select light rich soil. Broadcast seeds and thin out 22.5 to 30 cms. apart. Water freely. Stir soil frequently. Pinch off flowering shoots. Ready in 10–12 weeks. Spinach degenerates from acclimatised seeds.

Spinach, New Zealand. (*Tetragonia expansa*. Chenopodiaceae).

A hardy annual which grows $\frac{1}{2}$ metre high with a good spread, producing an abundance of fleshy brittle leaves and young stem tips that can be picked repeatedly. When prepared, they resemble Spinach in flavour and appearance. Sow seeds in nursery beds. When 10 cms. high, plant out $\frac{1}{2}$ metre apart, in rows $\frac{3}{4}$ metre apart. Water freely and keep free from weeds. Ready in 75 days.

Tomato. (*Solanum* or *Lycopersicum esculentum*. Solanaceae). Vern. “Bilayati Baigan”; “Seeme Takkali”.

Known as the Love Apple. A native of S. America, grown for its popular nutritious fruits, rich in vitamins. Good results obtained from acclimatised seeds. Can be grown in any kind of soil but well manured loam gives best results. Sow seeds, in plains, July to November, in hills, from March to June, in seed-pans or nursery beds. When 7.5 to 10 cms. high, transplant $\frac{1}{2}$ metre apart in rows $\frac{3}{4}$ metre apart. Apply water frequently in dry weather. If the plants are allowed to spread on the ground, the fruits get damaged and begin to rot, when they touch the ground. Therefore, support the plants with stakes 1 to $1\frac{1}{2}$ metre high or train them against a short trellis. Remove laterals and offshoots and nip off the top, when the stem has produced 4 to 6 clusters of flowers. It will be noticed that the flower clusters are borne not in the axils of the leaves but opposite to them. When the fruits are setting, apply liquid manure and potash manure. Thin out fruits in the bunches, if large ones are desired. Remove a few

leaves, if necessary, to admit more light to the fruits. Pull out all diseased plants and burn them to prevent spread of disease to other plants. Collect all rotted fruits and throw them out. Tomato is subject to several diseases. Wilt disease is the commonest. Syringe the plants every ten days with a weak solution of permanganate of potash or Bordeaux mixture. This will prevent disease to some extent. For wilt disease, sterilize by digging in lime and exposing the soil to sun for a season. If the soil is infected, grow only "wilt resisting" varieties, after fallowing. Do not grow Tomatoes in the same soil successively. Collect seeds only from large disease-free fruits. 30 gms. of seed will provide about 1,500 plants.

Varieties.—For very large fruits, Oxheart, Brimmer and Ponderosa; Marlgobe is a favourite variety; Stone, Rutgers, Globe, Golden Queen, Selection 120, Kaki, Bonny Best, Indian Red round are other good varieties; Yellow Plum, Yellow Pear, as also the pear-shaped scarlet variety called King Humbert are immensely productive small fleshy varieties, best suited for growing in the hot season, when fruits of large varieties are liable to sun-scald.

Turnip. (*Brassica rapa*. Cruciferae). Vern. 'Shalgam'. Grown for its fleshy roots. Suited better for medium to high elevations than the plains. Sow, plains, September to end of November, hills, middle of February to middle of June. Sow thinly in drills 30 cms. apart in well prepared beds. Water young plants not too frequently. Thin out 15 to 22.5 cms. apart. Stir soil now and then. Guard against Turnip fly by spraying with soap solution. Ready in 60-90 days.

Varieties.—Early Snow Ball; Golden Globe; Purple-top White Globe.

Vegetable Marrow. Squash. (*Cucurbita pepo*. Cucurbitaceae). Vern. "Vilayati Kumra", "Seeme Kumblakai".

Allied to Pumpkins and grown like them. Generally unsuited for lower elevations. Two types :—(1) Summer Squash and (2) Fall or Winter Squash. The former, best for eating when immature—delicious, if cooked whole when small; the latter produce hard shelled fruits which are allowed to grow to their full size and used for pies, curries etc. In both types, there are several varieties the fruits

varying in size, shape and colour of the skin, which may be green, cream, yellow or orange—the taste and flavour being almost the same. There are both bush and trailing forms, the latter being more common. Sow, plains, September to end of November, hills, March-June. Prepare holes, $\frac{1}{2}$ cubic metre, fill them with a mixture of well decomposed cattle manure and soil. Let the holes be $1\frac{1}{2}$ to 2 metres apart, as the vines spread freely on the ground. For bush types, the holes may be one metre apart. Gourd-like fruits are produced. Pinch the tops of the shoots when flowers open to induce them to set-fruit. The plants produce male and female flowers separately and very often for setting fruits, artificial pollination of female flowers has to be effected. Female flowers are distinguished by having no pollen and by having a large round ovary. Ready in about 3 months.

(B) TROPICAL VEGETABLES

The following are well-known country vegetables:—
The botanical name of the vegetable is given first, then, the common name and the family name is in brackets. Vernacular names are also given as far as possible,

Amaranthus. Greens. Several species of. (Amaranthaceae).
Vern. 'Sag': 'Keerai'; 'Soppu'.

Many types of soft wooded annuals, the leaves and tender stems of which are used as vegetable. They vary in size and are green or red stemmed. Easily grown on any soil, best results being however obtained in light rich soil. Broadcast thinly in beds if only small stems are required for use. If grown for 'thandu' or thick stems, sow thinly in drills, 30 cms. apart and thin out to 30 cms. Ready in 30 to 40 days. Can be grown throughout the year.

Basella alba, rubra and cordifolia. Ceylon spinach or Malabar Nightshade. (Chenopodiaceae). Vern. 'Basale'; 'Pooye sag'.

Perennial climber with soft green or purple stem and succulent leaves, used as a substitute for Spinach. Any soil will do. Sow seeds direct in filled pits and support vines. Ready in 3 months.

Belincasa cerifera. Ash Pumpkin or White Gourd. (Cucurbitaceae). Vern. 'Panee Kumra', 'Bhatwa', 'Sachi', 'Pusinikai', 'Budikumbla'.

An extensive annual climber, allowed to spread on the ground, bearing large oval fruits covered with an ash-coloured bloom. Fruits are watery; used in curries and for making sweetmeat. Make broad pits, 45 cms. deep and 3 metres each way, and fill up with richly manured light soil. Let the pits be 2 metres apart. Sow five seeds, in each pit directly, in February-March. Keep only one plant, the strongest plant, in each pit. Keep free from weeds. Water regularly. Ready in 3-4 months. Not grown above 1,000 metres.

Beta maritima. Indian Spinach Beet. Vern. "Palum"; "Palak Sag".

Soak seeds for a day. Broadcast in beds in October. Thin out 25 to 30 cms. when 10 cms. high. Ready in about a month.

Cajanus indicus. Dhal. Pigeon Pea. (Leguminosae). Vern. 'Dhall'; 'Arhar'; 'Thor'; 'Thuvarai'; 'Thogari'.

The dried and split seeds form one of the chief pulses of India. An important article of food. The green seeds taken out of the pods as Peas are used like them as a vegetable. A shrub, 1½ to 2 metres high, drought-resisting and easily cultivated. Sow seeds in rows, 1½ metres apart, thinning out to stand 1 metre apart in the rows. Ready in about 4 months for the use of green seeds as vegetable.

Canavalia ensiformis. Sword Bean. Jack Bean. (Leguminosae). Vern. 'Bara Sem'; 'Awarakkai'.

A woody perennial climbing Bean, bearing pods, 15 to 30 cms. long and 2.5 to 4 cms. broad, which when young and tender, are sliced and boiled as vegetable or used for pickling. The red or white seeds are also used like Double Beans. Sow seeds direct in broad pits filled up with rich soil about 7.5 cms. deep. Train the vine over a bamboo support and then over a pandal. The vine may be allowed to go up a tree also. Does not thrive in places about 1,000 metres. Subject to aphid pest. Ready in 3 to 4 months.

A dwarf form of the above is more popular. It grows $\frac{2}{3}$ to $\frac{3}{4}$ metre high. Sow seeds in rows $\frac{1}{2}$ metre apart, the distance from plant to plant in the rows may be $\frac{1}{2}$ metre.

Capsicum. Chilli. Pepper. (Solanaceae). Vern. 'Mirich'; 'Mulakai'; 'Menasinakai'.

Bushy annual small plants, too well known to need any description. The 'Chillies' bear pungent and hot fruits, used for spicing. They are generally small and longish and distinguished from Capsicums, which are generally large, round, or oblong, wrinkled and hollow and not pungent and therefore used as a vegetable, boiled or raw as a salad. Some varieties as Chinese Giant bear fruits 7.5 to 10 cms. in diameter and 10 to 12.5 cms. long. The hot types are best grown in the plains. The mild types are better suited for medium to high elevations. But, they may be grown in the plains, successfully in the cold season. Sow generally, plains, April to middle of June, hills, April to end of May. Broadcast seeds in beds in the open and when about 10 cms. high, transplant seedlings 30 cms. apart, in rows 45 cms. apart. Any good soil slightly manured gives good results. Ready in $2\frac{1}{2}$ –3 months. 30 gms. of seed furnishes about 1,500 plants.

The young fruits of some kinds are yellow or cream coloured or blackish purple. Some are very ornamental with their fruits and make good pot plants. There are several non-descript varieties of the hot type. Cayenne Red is a well known variety, with long thin pods. Among the less pungent long varieties, Elephant's Trunk is the best. Well known mild flavoured varieties are:—Chinese Giant, Ruby King, Golden Queen, Bull Nose and Sunny Brook.

Chenopodium album. Vern. 'Bethua'; 'Chakwat Baji'.

An erect herb, the leaves used as greens. Grown like Amaranthus in prepared beds.

Citrullus vulgaris. Water Melon. (Cucurbitaceae). Vern. 'Kharbuza'; 'Kallangare'.

A trailing gourd, usually grown in dry beds of rivers producing fruits for desert. Several varieties some more sweet and juicy than others, and differing in size and shape of fruits. Heavily manured sandy soil produces best fruits. Grown like Ash Pumpkin. Sow about the middle of January

to have the fruits in season during the hot dry months. If the collar of the plant is allowed to get too wet, the stem will canker and the plant die. Ready in 4-4½ months. Not grown above 900 metres.

Citrullus vulgaris variety fistulosus. **Squash Melon.** Vern. 'Dilpasand'; 'Tinda'.

A variety of the preceding kind, with a fruit about the size of a Turnip, dark green in colour when young and usually lemon-yellow, when ripe. Grown like the Melons, in patches, one metre apart. Pick fruits when three-fourths grown, pare, cut them into quarters, extract the seeds, boil in water, and then in a little milk, with salt, black pepper and nutmeg. Sow February to March. Ready in about 3 months.

Cucumis Melo. **Musk Melon.** **Cantaloupe.** (Cucurbitaceae). Vern. 'Kharbuja'; 'Mulam Pasham'.

Grown like Water Melon in similar soil and under similar conditions. Ready in 3 months. The fruits vary in size and shape according to variety, but usually 18 to 20 cms. in diameter. Used as a desert fruit when ripe. Not grown on hills.

Cucumis Melo, variety momordica. **Melon.** Vern. 'Kachra'; 'Tuti'.

Grown like the above. A variety of the common melon, with smooth cylindrical fruits about 30 cms. long, green when young and lemon-yellow when ripe. Used like Cucumber for salad when young and eaten like Melon, when ripe, with sugar. Ready in about 3 months.

Cucumis Melo, variety utilissimus. **Cucumber.** Vern. 'Kakri'.

Bears long fruits, green while young and yellowish when ripe. Used for salad while young. When ripe tastes like an insipid Melon. Grown like Melons, by sowing in pits filled with rich sandy loam, 1½ metres apart. Ready in 3 months.

Cucumis sativus. **Cucumber.** Vern. 'Khira'; 'Sukasa', 'Valleri Kai'; 'Southe Kai'.

The varieties enumerated in English and American catalogues are too delicate for cultivation in the open in this country. There are local varieties which thrive to perfection.

Sow, plains, from the beginning of February to end of June, and hills, from March to May. Dig pits 45 cms. by 45 cms. at a distance of $1\frac{1}{4}$ by $1\frac{1}{4}$ metres, and fill with well decomposed manure. Plant 5 seeds in each hole and thin out to two strongest growers. Allow plants to trail over the ground. Mulch the roots during dry weather. Ready in about 75 days and bears for six weeks or more. Don't allow fruits to ripen on the plant, as it diminishes its productivity. Red beetles eat the leaves. These may be kept away by dusting ashes on the leaves or by spraying insecticide.

Cucurbita moschata. Pumpkin. (Cucurbitaceae). Vern. 'Kumra'; 'Seekumbalakai'; 'Parangi'.

Annual of trailing habit, grown throughout India, for the fruit, which is cooked and dressed, both in immature and ripe state as vegetable. There are many varieties, fruits of which are generally large but varying in shape and colour. The colour of the skin varies from greenish-white to brownish-red but the flesh is salmon-red or reddish in all kinds. Make broad pits, 2 metres apart, and fill them with light soil enriched with manure. Grow like other Cucurbitous plants mentioned above. Ready in 3-4 months. Sow from February to June, in the plains, and from March to July on the hills.

Cyamopsis Psoralioides. Cluster Bean. (Leguminosae). Vern. 'Guar'; 'Kottavarai', 'Gorikai.'

Small bushy plant growing to about $\frac{3}{4}$ metre, producing hairy pods, about 7.5 cms. long, in clusters, which are used as vegetable like snap Beans. Sow seeds in drills, 45 cms. apart, and thin out to 20 cms. apart in each row. Sow, February to June. Ready in about $2\frac{1}{2}$ months.

There are two varieties, one bearing longer and larger pods than the other.

Dioscorea species. Yam. (Dioscoraceae). Vern. 'Ratalu', 'Kham Alu'; 'Kodi Kilangu'; 'Ala'.

There are several species of Dioscorea, known as Yams. Herbaceous climbers, with annual stems and perennial coarse tuber-like roots of varying sizes, which are prepared for food like Potato-roasted, baked or boiled. Constitute the poor man's food and vegetable in W. Indies, Tropical America,

Ceylon and S. India. Grow well up to about 750 metres in well drained deep soils.

The best time to plant is from March to May. Make pits $\frac{1}{2}$ metre broad and $\frac{3}{4}$ metre deep, filling them up with light sandy soil enriched with decomposed cattle manure. The pits may be one metre apart. Plant bulblets or pieces of the head or crown with 2 or 3 'eyes' in them 7.5 to 10 cms. deep. Stake the plants with stout poles for supporting the vines. When the leaves turn brown and fall and the vines die down, the crop is ready for lifting, which will be in about 9 months after planting.

The species commonly grown are *D. alata*, *fasciculata*, *spicata*, *obcuneata*, and *bulbifera*.

Dolichos lablab, var. Indian Flat Beans. (Leguminosae). Vern. 'Sem'; 'Makhan Sem'; 'Avarekkai'; 'Chapparada Avarekai'.

Perennial climbers, but grown as annuals, sowing seeds every year in June. Several varieties with white, pink or purple tinted flowers, which are followed by clusters of pods, which are flattish with warted or wavy margins, varying in size from 7.5 to 15 cms. long and 1.5 to 5 cms. broad. They are creamy white, purple tinted or green in colour. Tender pods used like snap Beans. Seeds are varied in colours, black, reddish, cream, speckled etc., as in French Beans.

Dig pits, $\frac{3}{4}$ metre broad and $\frac{1}{2}$ metre deep and $1\frac{1}{2}$ metres or more apart. Fill up after mixing the soil with cattle manure. Sow 5 seeds in each basin, 2.5 to 4 cms. deep. Retain 2 strong plants in each pit. Support them with tripods of strong poles, $1\frac{1}{2}$ to 2 metres high or train them over a pandal. The vines make vigorous growth during the rainy season and bear flowers, just after the rains.

Hibiscus esculentus. Okra. Gumbo. Lady's Finger. (Malvaceae). Vern. 'Bhindi'; 'Bendekai'.

Erect growing annual, $\frac{1}{2}$ to $1\frac{1}{2}$ metres high, bearing large leaves, Hibiscus-like flowers, horn-like pods, green or creamy green in colour and 10 to 22.5 cms. long. Pods gathered and used when still tender and free from fibre. The test for tenderness is tips of the pods should break easily when bent over. Sow, lower and medium elevations, March to August. Thrives

in ordinary soil, if manured well. Sow seeds in rows, $\frac{1}{2}$ to $\frac{3}{4}$ metre apart. Later on, thin out the plants to stand 35 to 60 cms. apart in the rows, according to the growth of the variety. Make sowings every 3 weeks for regular succession of pods. Ready in 60 to 75 days.

Clemson Spineless, American Long Green, and White Velvet are the best imported varieties. There are several local good smooth podded strains like Pusa sarwani and Red wonder mammoth.

Hibiscus Sabdariffa. Rozelle. Indian Red Sorrel. (Malvaceae). Vern. 'Patwa'; 'Lal Ambari', 'Gonkura'; 'Pulichha Keerai'.

A perennial, growing 1 to 2 metres high. Usually grown as an annual, being raised from seeds every year. The stem, leaves and fruits are reddish. There is a green variety also. The young, tender, acid leaves are used as a vegetable. The plant is, however, grown for its fleshy large sepals, which when fully formed are used in tarts, for making jelly, and in soups. Thrives up to 1,000 metres. Sow seeds in well prepared nursery beds in April-May. When 10 cms. high, transplant into rows $1\frac{1}{4}$ metres apart, with a distance of one metre between the plants in the rows. Ready in 5-6 months.

Ipomoea batatas. Sweet Potato. (Convolvulaceae). Vern. 'Mitha Alu'; 'Shakkar Kand'; 'Sakkarai Velli Kilangu'; 'Genasu'.

A climbing plant belonging to the Convolvulus family, producing tubers from the nodes of shoots, which are buried in the soil. The tubers are about 15 cms. long, pointed at both ends and swollen in the middle, sweet to taste, dirty white or red skinned, there being two varieties. Lightly manured sandy soil is best suited. Plant 22.5 cms. cuttings of the vine in April-June, 45 cms. apart, on ridges of shallow trenches, made $\frac{1}{2}$ metre apart. When these are grown, press down the stems every $\frac{1}{2}$ metre. Turn over the creeping stem frequently so that it may not emit roots at every node, otherwise, tubers do not develop to good size. Ready in 4-6 months. Does not thrive above 1,000 metres.

Lagenaria vulgaris. Bottle Gourd. (Cucurbitaceae).
 Vern. 'Alkadoo' ; 'Lauki' ; 'Sorekkai' ; 'Sore Kai'.

An annual climber like the Ash Pumpkin and grown like it. The fruits are light green and are of varying sizes and shapes. The most common are the round pumpkin-like variety and the long variety, often developing to $\frac{3}{4}$ metre, with a curved neck. Half ripe tender fruits make a good vegetable. Sow February to March and again August to September, in the plains ; on the hills, from April to end of May. Ready in 3 months.

Luffa acutangula. Club or Ridge or Sponge Gourd. (Cucurbitaceae). Vern. 'Kali Tori' ; 'Tori' ; 'Jhinga' ; 'Pirkangai' ; 'Heerekai'.

A climber, bearing green fruits, 25 to 45 cms. long, with sharp ribs projecting from end to end. Used, when tender, before the inside becomes tough and fibrous. A very good vegetable, when peeled, boiled and dressed with butter, pepper and salt. Sow February to May in filled pits, with a distance of $1\frac{1}{2}$ metres in between. Pinch back the shoots to induce the fruits to set well. Ready in 2-3 months, there being early and late types. Not grown above 1,000 metres.

Luffa aegyptica. Cylindrical Sponge Gourd. Vern. 'Dhande' ; 'Ghiya Tori' ; 'Tuppada Heerekai'.

Large herbaceous climber, similar to the preceding, bearing fruits 20 to 30 cms. long and without ridges and used likewise. Plant 2 to $2\frac{1}{2}$ metres apart in well filled pits in March-June. Not grown above 1,000 metres. Can be grown up a tree or pandal.

Manihot utilissima. Tapioca. Cassava. (Euphorbiaceae). Vern. 'Mara velli kilangu' ; 'Mara genasu'.

A native of Tropical America, a large shrubby plant, with erect stems and palmately divided long-stalked leaves and fleshy large roots, full of starch and used as vegetable. The roots contain prussic acid which is a poison and is eliminated by roasting or boiling. A cheap food for the poorer classes. Suited for elevations up to 1,000 metres. Resists drought and easy to grow. Deep, rich friable soil needed. Plant cuttings of stems, 30 cms. long, 90 cms.

apart in rows 1 to $1\frac{1}{2}$ metres apart. Tubers ready for lifting in 9–12 months.

Momordica Charantia and dioica. Carilla fruit. (Cucurbitaceae). Vern. 'Karela'; 'Pavakkai'; 'Hagalakai'.

Slender climber, bearing oval or long warty fruits of green or cream colour and of bitter taste. Immature fruits, when properly cooked and prepared are agreeable to some. There are summer and rainy season varieties. The summer types are 2.5 to 10 cms. long or oval in shape. Grown like Cucumber, the plants allowed 'to spread on the ground. The rainy season types bear long fruits, of 12 to 25 cms. and not so swollen in the middle as the summer types. They are grown in pits made one metre apart and supported on poles. Ready in $2\frac{1}{2}$ –3 months. Sow hot season varieties in February–March and the rainy season varieties in June–October. Not suited for hills.

Pachyrhizus angulatus. Potato Bean. Yam Bean. (Leguminosae). Vern., Bengalee and Sanskrit. 'Sankhalu'.

Synonymous with *Dolichos tuberosus*. A climbing herb like the Climbing French Beans, but with tuberous roots, a native of Tropical America, introduced to India and Ceylon about 1890. Can be cultivated easily throughout India with heat in good soil. Grown like other Climbing Beans, sowing the seeds 37.5 to 45 cms. apart in rows one metre apart. The plants need to be supported by poles or bamboos. The pods are edible only while quite young. The mature ones are 15 to 20 cms. long. The roots produce edible tubers which are 15 to 20 cms. long and quite as thick in about 2 years. They may be eaten raw after peeling off or cutting away the thick skin, the white inside having the consistency of Turnip and the flavour of French Beans. The tubers may also be boiled and eaten and are useful in times of scarcity. They may also be sliced and made into chips as those of Potato. A vegetable which is not much known but is worth popularising.

Physalis Peruviana. Cape Gooseberry. (Solanaceae). Vern. 'Teparee'; 'Gudde Hannu'.

Dwarf shrub, growing to about $\frac{1}{2}$ metre, bearing a well known berry, which is enclosed in a dry papery capsule.

Berries eaten when ripe; nice when stewed; also used for making jam. Sow in nursery bed in April to June. When seedlings are about 7.5 cms. high, transplant in rows of trenches $\frac{1}{2}$ to $\frac{3}{4}$ metres apart, with $\frac{1}{2}$ metre from plant to plant. Earth up the stems lightly, when about 22.5 cms. high, as the plants do not stand water-logging. Ready in about 6 months.

Psophocarpus tetragonolobus. Goa Bean. Four Angled Bean. (Leguminosae).

Strong climber like the Indian Flat Beans; a perennial but grown annually from seeds. Cultivated like Dolichos. Pods are green, peculiarly four angled, with a leafy fringe along the angles, 15 to 20 cms. long. Sliced and cooked like Beans tender.

Raphanus. Radish. See page 573.

Solanum incertum. (Solanaceae). Vern. 'Manathakali', 'Ganeke'.

An annual, 35 to 60 cms. high, bearing bunches of small flowers followed by tiny tomato-like round fruits of less than $\frac{1}{2}$ cm. diameter. Fruits are scarlet or black in colour, when ripe. The leaves are used as greens. The unripe green fruits and the ripe fruits are dried and preserved for use when wanted or pickled. Ripe fruits may be eaten as they are. Both leaves and fruits are considered good for health.

Solanum melongena. Egg Plant. Brinjal. Aubergine. (Solanaceae). Vern. 'Baigun'; 'Kathirikai'; 'Badnekai'.

A well known vegetable. The plant is a perennial soft-wooded shrub, but grown annually, throughout India. Not grown above 1,000 metres. There are several varieties, the fruits differing in size, shape and colour. Sown in September and October and in February-March, for fruits in February-March and August-January respectively. Sow in nursery beds thinly. Transplant seedlings twice before planting out for best specimens of plants and fruits, at intervals of 15-20 days. Plant then in rows of round pits, 60 cms. in diameter and 45 to 66 cms. deep, made 60 cms. apart and filled with light soil enriched with cattle manure putting 3 seedlings into each pit. Or, put the plants in rows in well filled trenches

60 cms. apart setting the plants 60 cms. apart. Earth up lightly when about 45 cms. high, putting well decomposed manure round the plants. Plants grow $\frac{1}{2}$ to $\frac{3}{4}$ metres high and bear in $3\frac{1}{2}$ -4 months. Red ants, which bore through the stems, aphids, mealy bugs, and small beetles and stem boring caterpillars are the common pests. Prune back the wilting shoots and branches and burn them, as the caterpillars are in them. For the epilachna beetles attacking the foliage, spray with strong insecticide solution. Cut back the shoots of plants, after the first flush of fruits are over for new growths and further crop of fruits. Giant of Banares. New York Spineless, Black Beauty, Mukhthakesi, Long Purple, Long white, Pusa purple long are a few of the innumerable varieties.

Trichosanthes anguina. Snake Gourd. (Cucurbitaceae). Vern. 'Chachenda'; 'Podalangai'; 'Padwalakai'.

A quick growing gourd bearing large cylindrical snake-like fruits often 1 to $1\frac{1}{2}$ metres long, green or ash coloured with whitish lines on them. Not grown above elevations of about 1,000 metres. Sow five seeds in a broad well filled pit in March-April, or even in May. Let the pits be $1\frac{1}{2}$ metres apart. When the plants have begun to grow, earth lightly up the stems and put brambles about $1\frac{1}{2}$ metres high, for the vines to climb. Then, allow the vine to spread on an improvised pandal. The gourds hang down the pandal. Tie strings to the ends of the fruits, weighted with small stones, for the gourds to grow straight. Ready in about 3 months. A delicious vegetable. There are two varieties, short and long, striped green or pure ash grey.

Vignus sinensis var. sequipedalis. Asparagus Bean Snake Bean. Yard Long Bean. (Leguminosae). Vern. 'Lobia'.

A twining annual bearing long pods, $\frac{1}{2}$ to $\frac{3}{4}$ metres long by 1 cm. broad, used like French Beans, when tender, being sliced and cooked. Suited for low and medium elevations. Grown like Runner Beans. Sow March-July. Ready in about 70 days.

Zea Mays. Indian Corn. Sweet Corn. (Gramineae). Vern. 'Bhutta', 'Makkai', 'Jola', 'Cholam'.

Well known cereal, grown throughout India for its grains and more especially for its cobs in home gardens. In the green stage they form a very agreeable vegetable, cooked or roasted. It is an annual grass growing about, $1\frac{1}{2}$ metres high, bearing one or more cobs per plant. There are several varieties. Golden Beauty, Sugar Corn, Kendal's Giant, Burpee's Delicious are some of the improved good varieties. The first named is the best market variety. Sow from March-June in the plains, and May-July, on the hills. Acclimatised seeds give best results in the plains. Imported seeds may be sown in the cold season. Soil should not be too rich. Sow seed in drills, which are $\frac{3}{4}$ metre apart, 5 cms. deep, placing the seeds 15 cms. apart in the rows. Let the rows form square blocks of $2\frac{1}{4}$ metres so that the plants may grow close to each other, otherwise, for want of cross-pollination, the cobs are not well filled. When plants are well up, thin them out to 45 cms. apart, and earth up to a height of 10 cms. Ready in $3\frac{1}{2}$ months. Sow every 15 days for successional crops.

SOME SEASONING HERBS

Anise (*Pimpinella anisum*). Umbelliferae. Vern. 'Sauf', 'Mauri'.

Broadcast seeds in beds or sow in drills, 37.5 cms. apart in October-November. Thin out 15 cms. apart. Ready in 3- $3\frac{1}{2}$ months. Both seeds and celery-like leaves are used for seasoning and flavouring.

Basil, Sweet (*Ocimum bacilicum*). Labiatae. Vern. 'Gulal thulsi'.

Leaves and tops of shoots are used for seasoning dishes and introduced into salads too. Grows all the year round. Sow in nursery beds and transplant 30 cms. apart or grow in pots.

Caraway (*Carum Carvi*). Umbelliferae. Vern. 'Jira'. Seeds used for flavouring and in confection. Sow June-November and thin out 20 to 30 cms. apart.

Coriander. (*Coriandrum sativum*). Umbelliferae. Vern. 'Dhania', 'Kothamalli'.

Seasoning herb. Broadcast in beds. Thin out 10 to 20 cms. apart. Ready in $2\frac{1}{2}$ -3 months.

Dill (*Peucedanum graveolens*). Umbelliferae. Vern. 'Sowa'.

Broadcast seeds or sow in shallow drills and thin out 30 cms. apart. Grows to about $\frac{1}{2}$ metre. Aromatic leaves used in soups, sauces, etc., and also for making "Dill-water" for children. Ready in about $3\frac{1}{2}$ months.

Fennel. (*Foeniculum vulgare*). Umbelliferae. Vern. 'Sunf'.

The tall finely divided aromatic leaves are used in sauces, for garnishing, etc. Leaf stalks are used in salads. Seeds used in confectionary and for flavouring liquor. Suited best for elevations above 500 metres. Sow in boxes and put out in rows 30 cms. apart.

Lavender. (*Lavendula vera*). Labiatae. Vern. 'Nurd'.

Succeeds only from medium to high elevations. Dwarf shrub, grown for its pleasantly aromatic flowers which are dried and put into wardrobes. Leaves are used for seasoning. By distillation of flowers, Lavender Water of commerce is obtained. Sow in seed-pans and transplant when fit to handle into small pots and shift to larger pots later on. When about a year old, plant them out in well drained soil. Apt to damp off in the rainy season.

Marjorum, Sweet. (*Origanum marjorana*). Labiatae. Vern. 'Bantulsi'.

Suited for hill stations. Sow in August-September. Plant seedlings 20 to 25 cms. apart. A perennial, which becomes ready in about $3\frac{1}{2}$ months. The aromatic leaves are used, both green and dried, for seasoning soups, etc.

Mint, Spear Mint. (*Mentha viridis*). Labiatae. Vern. 'Pudeena'.

Herbaceous perennial with creeping rhizomes. A valuable seasoning herb, the tops and young leaves used for flavouring, in salads and sauces, etc. Slight shade necessary, and plenty of water. Plants raised by division of roots and underground stems, which are planted 20 cms. apart. Moist rich soil gives best results.

Mint, Peppermint (*Mentha piperita*). Resembles the common Mint. Likes shady situation.

Parsley. (*Petroselinum sativum*). Umbelliferae. Vern. 'Peterssee or Ajmud'.

Known for its medical properties. Universally grown for seasoning and garnishing purposes. Thrives best from medium to high elevations but can be grown tolerably well at lower elevations too. Select rich heavy soil. Secure partial shade. Sow, plains, August–November, and hills, March–May. Germination is slow, taking about 15 days or more. It can be hastened by soaking the seeds in water for a few hours before sowing. Mix them with ashes and sand before sowing. Broadcast them or sow in drills and then thin out 22.5 to 30 cms. apart. Water moderately. When flower buds appear, cut them back. Ready in 1½–3 months.

Rosemary (*Rosemarinus officinalis*). Labiatae. Vern. 'Husalban'.

Dwarf shrub, grown for its pleasantly fragrant leaves which are used for seasoning, for making decoction for relieving headache and in the manufacture of scents. Suited only for hill stations. Grown from seeds and cuttings.

Rue. (*Ruta graveolens*). Rutaceae. Vern. 'Sundub'.

Does better at hill stations. Can be tried at medium elevations. Small undershrub with glaucous greyish leaves, which have an unpleasant smell and a hot bitter taste. Used in garnishing for its carminative properties. Grown from seeds or from cuttings.

Sage. (*Salvia officinalis*). Labiatae. Vern. 'Seesti'.

A well known seasoning plant, grown successfully on hill stations. Sow seeds in October and November at medium elevations. Transplant into pots when 7.5 cms. high. Grow in pots or plant out 30 cms. apart. Best grown in pots at low elevations.

Thyme. (*Thymus vulgaris*). Labiatae. Vern. 'Hasha'.

Grows best from medium to high elevations. A favoured seasoning plant. An undershrub which prefers a light rich dry soil, and sheltered situation. Sow in drills 20 cms. apart and thin out 7.5 cms. apart. Ready in 3½ months. In the plains, best grown in pots.

CHAPTER XXX

SELECT FRUITS

Suitable positions for fruit trees.—The owner of extensive grounds may with pleasure and profit grow a selection of fruit trees and shrubs. Quite a large number of them which are ornamental with handsome foliage and fruits, may be, suitably planted along with the ornamental trees and shrubs. It is needless to mention, however, that they should be provided situations agreeable for their growth and that they should be so placed as not to mar the picture of the garden.

Where grounds are extensive, such large trees as the Jack, Mango, Jamoon, Wood Apple, Rose Apple and its allies, Bael, Star Gooseberry, *Phyllanthus Emblica* (Amla) and the Coconut are best planted on the confines. Trees smaller than the above as the Sapota, Loquat, Guava, Custard Apple and other Anonaceous kinds, Komrac, Citrus kinds, Tree Tomato and the Mulberry may be grown in the second line along with other trees and shrubs completing the landscape view. Such handsome trees as Litchi, Pommelo, Oranges like the Kumquat, Brazil Cherry and the like are best planted to beautify the lawn. The Bread Fruit tree with its graceful habit and handsome large polished leaves would be effective placed in front of the porch or on the sides of the bungalow.

Trees as the Peach, Apple, Fig, etc., can be grown by sheltered walls and hedges. The Papaya which in its young stage is ornamental with its large leaves and attractive fruits covering the stems, may be planted by compound walls screening them, and when old, their naked stems may be used as supports or pillars for effective display of annual creepers as *Convolvulus*. Pine Apples make a good show with their ornamental foliage, planted in beds along walks and paths. Thus, it would be seen that several fruit trees, shrubs, and plants can be mixed up with those grown only for ornament, without allotting a separate place for them in the garden scheme.

Suitable site, soil, etc.—As fruit trees need more individual attention than ornamental trees, it is, however, economical to grow them in a separate site. Each kind is best planted in a separate bit, as trees of one kind call for similar treatment. The site chosen should command good drainage, be fully exposed to sun, and be sheltered from strong winds by an effective windbreak of trees like *Sesbania* ('Agati') and *Erythrina indica* ('Pandara') or *Synadenium grantii* ('Milk Bush'), planted at right angles to the direction of the strong winds. Fruit trees thrive best in well drained deep loam—at least $1\frac{1}{2}$ metres deep with the water table not less than $1\frac{1}{2}$ metres below the surface of the soil at any period of the year. They also thrive in soil which has a layer of $\frac{1}{2}$ metre of loam at top with porous gravelly but not stony soil below. In clayey or very heavy soil, the roots suffer by water-logging and improper aeration. In stony soil, the roots cannot travel deep enough in search of food and water, and the trees cease to grow and bear after a few years. Sand and sandy loam are also unsuitable as they cannot retain moisture and manure and get easily heated during the day and cooled during the nights and thus adversely affect the trees. A good supply of water is necessary, especially in summer, for the growing trees. Unless the trees are treated liberally with water and manure so that they may grow well, it is hard to expect them to bear well and for a number of years. Trees neglected by want of seasonal manuring and timely watering seldom regain their vigour and health.

Preparation of land for planting.—After selecting a suitable site, the first business is to clear it of all weedy shrubs and under-shrubs. Plough the land deep and remove all weeds and grass roots, and grow a crop of a Leguminous kind as Groundnut or Horsegram or a green manuring plant and dig it in when ready, to make the soil soft and mellow, to enrich it with nitrogen, and to keep down weeds during succeeding years. When the land is thus prepared, positions for the pits for planting are marked out. Generally, shrubs may be planted $1\frac{1}{2}$ to $2\frac{1}{2}$ metres apart, small trees 4 to 5 metres, and larger trees 6 to 10 metres apart. When they are fully grown, they should not overcrowd each other;

each tree should be free from the shade of the branches of its neighbours and should get an adequate amount of direct sun and air. How pits are to be made and filled with soil has been dealt with in Chapter VII. For fruit trees, it is desirable, the pits are at least 1 metre long, 1 metre broad and $1\frac{1}{2}$ metres deep, if the soil is not deep and good throughout. The bottom of the pits are best filled to a depth of 15 cms. with broken bricks, etc., of a porous nature for drainage and then to a further depth of about $\frac{1}{2}$ metre with the top soil mixed with a very liberal quantity of organic manure and 10 to 20 kgs. of crushed, bone or bonemeal. If the soil is good to a depth of at least $1\frac{1}{2}$ metres, it is enough if the pits are $\frac{1}{2}$ metre $\times$ $\frac{1}{2}$ metre $\times$ $\frac{1}{2}$ metre. The trees are best planted in rows diagonally thus or in squares thus : : : :

Selection of kinds and varieties to grow.—One has to take expert assistance in the selection of kinds and their varieties to grow and has to get plants from reliable nurserymen. As they take three to four years or more to grow and fruit, the disappointment would be the keener after growing them so long if the quality of the fruits is not to one's expectations. Unless the desire to be experiment with uncommon kinds and varieties, only tried kinds and varieties are to be grown for sure results. As seedlings take much longer to fruit than grafts or budded plants—as many as 8 to 15 years in the case of some kinds—and as there is no certainty of their coming true to their parent, budded or grafted or layered plants are preferred to them. The stocks used for budding or grafting should be suited to the local conditions of climate and soil. The plants chosen should be straight, young and not pot-bound. They should have the buds or grafts put as low down on the stocks as possible. Old pot-bound plants of more than one or two years have nothing to commend them except their size, which is after all of not much consequence. In the fruit-tree trade, much fraud is practised nowadays; grafts made easily by grafting young seedlings on seedlings are passed on as genuine grafts secured from fruiting trees. It is only scions taken from mature trees bearing fruits of superior quality that give the best results and that fruit quickly.

Layered plants are quite as good as graft or budded plants, provided the variety or the kind can thrive on its own roots in the soil of the particular locality.

Planting.—With regard to the season for planting, refer to Chapter VII. Imported deciduous trees as the Apple, Peach, etc., may be planted from November to February in the cold weather, when they are in their dormant condition.

Refer again to Chapter VII for general instructions regarding planting trees. Care is to be taken that the grafted or the budded portion is above the soil. The roots of plants if damaged, are to be cut back to healthy points before planting. The dried branches too should be cut back to healthy stem to prevent 'die-back'.

Should manure be applied while planting is a question often asked. It would be quite desirable to fill up the pits with soil freely mixed with manure, excepting the region of about 15 cms. all round the roots which should be friable earth or sand. In places infested with white ants, as manure attracts them, it is best to put the manure deep down and mix it well with soil below the roots. It may otherwise be spread on the surface of the soil round the tree, after the roots are established and growth has begun.

Care to be taken subsequent to planting. The trees are to be suitably staked while planting them. Basins have to be made for watering them. They have to be regularly watered so that they may not suffer any check in growth, especially during the hot months. The basins are to be widened as the trees grow in size. As observed at page 51, the feeding roots are away from the stem and it would be no good at all to water the trees in small basins around their stems. For larger trees, the basins should extend from $\frac{1}{2}$ to 1 metre of the stem to even 30 to 60 cms. beyond the actual spread of the branches. After each watering, when the soil shows signs of drying up on the surface, it is stirred to a depth of 2.5 or 5 cms. providing a dust mulch see page 30 which helps the moisture to be retained longer in the soil. In regions where rainfall is only 50 to 70 cms. or less, fruit trees are best irrigated once in two to four weeks especially in summer. This would keep the trees from wilting, healthy

and prevent fruit fall. Once or twice a year the trees are to be manured. The time for manuring is usually just before the commencement of the rainy season. But it should be adjusted according to the needs of the particular kind and done about a fortnight or a month before the blossoms are expected. For manuring, stop watering the plants for a fortnight; then remove the upper layer of the soil in the basins to a depth of 10-30 cms. until small hair-like roots are seen which should not be damaged; replace the soil with a mixture of red earth and manure, made in the proportion of one of the former to two of the latter. Sheep manure is best for Apples, Grape Vine, Peaches and such deciduous trees. For evergreens such as Citrus trees, cattle manure is preferable. If good manure is not available, leaf-mould may be used along with a mixture of artificial manures, made up of 2 parts by weight of bonemeal, 3 parts of potassium sulphate, 6 parts of ammonium sulphate, and 3 parts of superphosphate. 1 kg. to 2 kg. of the mixture may be used for a tree 1 to 2 years old and 5 to 12 kgs. may be used for older trees according to their age and size. The chemical manure should be mixed with three to four times its bulk of ordinary soil and then applied. Whenever chemical manure is applied, watering should be very liberally done, as otherwise, ex-osmosis takes place and the trees wilt, or even die. The area under the fruit trees should be ploughed or dug up every year to clear weeds and to enable the land to take in as much rain water as possible.

The stems of some kinds of trees, such as those of Citrus, get "sun-burnt" by exposure to severe sun, especially on the side facing the setting sun. The bark gets discoloured and becomes brown and assumes a dull dead appearance. It tightens its grip round the stem and prevents the circulation of sap inside as a result of which the tree may die in course of time. To prevent sun-burn, the stems are whitewashed. If the bark is not too far affected, the tree can be saved by a small operation effected as soon as the injury is noticed. The stem is slit from the ground level to the spread of the lower branches with clean vertical cuts with a sharp knife through

the bark in several places and coated with a thin splash of Bordeaux paste.

Pruning. Pruning of fruit trees has been dealt with in Chapter X. It should be emphasized that pruning of fruit trees in this country should be confined to initial shaping and later on to removal of over-crowding and dead and diseased branches. The advantage of pruning secured by the use of the knife such trees as the Apple, Peach, Pear, etc., in the temperate climate is obtained naturally in this hot country by the effect of severe sun. For want of a long winter, the sap is active always and the trees have no rest. So pruning in this country causes bleeding and consequent weakening of the plants. On the Hill Stations and in the extreme North India the methods of pruning adopted with reference to several kinds of trees may however be tried and these methods are indicated under the respective trees.

Failure to fruit. Sometimes large trees fail to fruit. This may be due to too vigorous a growth of the wood and foliage, which may be checked by such operations as root-pruning, girdling and wintering which have been described in pages 135-6. It may also be due to want of phosphorus in the soil, in which case, a liberal application of 7 to 12 kgs. of superphosphate for each large tree would induce it to bear. Want of pollination due to absence of male trees near by, absence of certain insects which fertilise the flowers, unfavourable weather conditions, as rains during the blooming period washing away the pollen are also responsible for failure to fruit. When the sexes are on different trees, it is helpful to grow more than one tree of the kind in question to be sure of pollination of the flowers. Too much water, very poor soil, very rich soil, and bad heredity are also causes for sterility among fruit trees.

Fruits, how collected and stored. Fruits which ripen on the tree are generally of a finer flavour and colour than those which are picked before they are ripe. Though they may soften and ripen later, they may remain to some extent acid and astringent. There are several pests as squirrels, rats, birds, etc., which necessitate however, the removal of fruits before they get ripe naturally. Fruits are forced to ripen by

wrapping them in straw or by allowing them to remain in trays in dry rooms without touching each other. Rotting of fruits is chiefly caused by the death of cells due to mechanical damage such as severe handling, fall from the tree and heaping. Special hooks, bags, etc., should be used for harvesting fruits without damage. Certain kinds as the plantain, are cut in bunches when just changing in colour from green to yellow and smoked in a closed atmosphere. It is only the disease-free mature fruits which are collected unbruised that keep well. An efficient cold storage may not be within the reach of all. It is an excellent method of preserving fruits over a comparatively long period.

Pests and Diseases. Refer to Chapter XI. Spraying in the right time with Fish Oil Resin Soap or Honge Oil Soap solution will eradicate sucking insects as green bugs, aphids, etc., and reduce the danger from sooty mould in the case of such trees as Citrus, Guava, Sapota, etc., which are usually attacked with it. Fungus attacks as mildew, leaf-spots, rusts, etc., are prevented by spraying with Bordeaux Mixture, first when the trees are naturally without leaf or when they are wintered, secondly when they break out into fresh foliage before they bloom, and thirdly, when the flowers have opened and the fruits are set and are about the size of a pea. To prevent certain fungus attacks of the fruits, as discolourations or rusts or spots on them and sometimes to prevent them from dropping away before they ripen, the fruits are sprayed with Bordeaux Mixture again when they have advanced fairly far in size. The several kinds of fruit flies which give rise to maggots inside fruits and which bore holes through them are best treated preventively by collecting and destroying the affected fruits by burning them and thus ensure a better crop next season.

Climatic conditions favourable for growing fruits. Fruit trees may be broadly divided into two classes: (i) tropical and sub-tropical, which thrive in varying altitudes from the sea-level to about 725 metres and (2) the temperate kinds which require a higher elevation in this country—say 725 to 1,200 metres or more above mean sea-level for satisfactory results. Even in these two classes, there are kinds which

show wider adaptability to climatic conditions than others. For instance, Citrus kinds thrive well at places from sea-level to 1,500 metres above it, and the Mango up to 900 to 1,000 metres. The Mangosteen, on the other hand, will not thrive above 400 metres preferring as it does a warm humid atmosphere. It may be generally observed that all fruit trees prefer a dry atmosphere at fruiting time to bear well and produce sweet and luscious fruits, to a very humid atmosphere. Humidity of the atmosphere, too much rain and too much of watering cause acidity in fruits. It is observed that fruits which ripen in summer are sweeter than those produced during the rainy season.

The following are select fruits :—

Acras sapota. Sapodilla Plum. Sapota. Naseberry.
(*Sapotaceae*). Vern. 'Chikku'; 'Sapota'.

Very hardy, evergreen, slow-growing, well-shaped tree, 5-6 metres high, with polished small elliptical leaves. Fruits are oval or round, 5 to 8 cms. in diameter, have a rough nut-brown skin, enclosing soft yellowish brown, very sweet flesh, which is fragrant and possesses a fine flavour. Firminger said : " A more luscious, cool and agreeable fruit is not to be met with perhaps in any part of the world". Unless fully ripe, it is unfit to eat, on account of the milky latex and tannin present in it. In U.S.A. the latex known as 'Chickle' is used commercially for making chewing gum. Collect the fruits unbruised, when the skin has become smooth and the spine-like dried part of the flower has fallen off the apex. Keep them in a dry place for about a week to ripen. The tree thrives best in rich sandy loam in a strictly tropical climate but it adapts itself excellently well to diverse soil and climatic conditions up to an elevation of about 1,000 metres. Fruits are borne plentifully from 100 in a young 3-year old tree to as many as even 2,000 in a large 15-year old one. Flowers are produced practically throughout the year at intervals of two months. The medium-large variety with round fruits bears throughout the year. There are some six or seven varieties, the fruits differing in size, shape and quality and the trees in growth and productivity. The very large 'Cricket ball' and 'Large Oval' varieties have coarse grained flesh and are lacking in

sweetness. They are also comparatively shy in bearing. As seedling plants take 8 to 10 years to fruit and do not bear freely, grafts obtained from mature select trees are to be planted. For grafting, the best stock is *Mimusops hexandra* (Vern. 'Palai'; 'Kirni'). The Indian Olive, *Bassia latifolia* (Vern. 'Mowha', 'Illuppai'), is often used as stock, though it is not desirable as the fruits would have a tinge of the bad flavour of the *Bassia*. Layered plants bear quite freely as grafts. But layering takes a very long time—as many as 9–12 months. Usually planted 4–5 metres apart in ordinary soil as the trees are slow growing. But, a spacing of 7½ metres would not be too much in irrigated fertile land. The fruits are very popular in the market and large commercial plantations are now made in South India. A native of Tropical America and West Indies. One of the best and hardiest plants to grow in the plains, with results in proportion to the care taken. After establishing the plants by watering them at intervals of a week or fifteen days for a year or two, they are able to survive total neglect, yielding fruits, better watered and manured trees producing larger and more fruits. Sapota is remarkably free from pests and diseases. Leaf scales (Green and Brown bugs) and sooty mould and stem-borers are the only troubles which are easily controlled.

Aegle Marmelos. Bael-fruit. Bengal-quince (*Rutaceae*).
Vern. 'Vilva', 'Bela', 'Bael'.

A useful spiny tree, allied in appearance to the Wood Apple. Fruits vary in size from that of a cricket ball to a melon. They have a hard green shell, enclosing an aromatic doughy pulp, which is squeezed in sugared water for making a beverage. They are well known for their medicinal properties, especially as a specific for dysentery. Refer to Watt's *Dictionary of Economic Products of India* for the medicinal and other uses of the various parts of the tree, on account of which the tree may be given a place in a large garden. Thrives in any garden soil up to an elevation of about 750 metres and bears in March–May. Get the large fruited thin shelled variety. Propagated from seeds, taking 6 to 8 years to bear. Native of dry forest areas in India. It is held to be a sacred tree, planted near shiva temples.

Anacardium occidentale. Cashew-nut. (*Anacardiaceae*).

Vern. 'Munduri-paruppu', 'Caju-gaha', 'Ger-pappu'.

A tree, indigenous to Tropical America, adapted to the dry and wet coastal regions up to an elevation of about 750 metres. Thrives in any kind of soil. It is awkward and ungainly in habit, evergreen, spreading, and reaching a height of about 9 metres. A relative of the Mango. The fruit consists of two parts, *viz.*, (1) the cashew apple, the swollen pear-shaped receptacle, which is fleshy, very juicy, about 7.5 cms. thick, and is often eaten raw. It is astringently acid rich in vitamin C and used in preserves and to make a drink; (2) the nut, which is kidney-shaped, about 2.5 cms. long, brown in color, and situated at the extremity of the flesh part. The edible nutritive kernel of the nut is of an agreeable taste after the nut is roasted, and it is used in confectionary and for flavouring purposes. Propagated from seedlings, which are planted out 9-12 months after sowing. Good varieties may be layered in the rainy season to be sure of the quality of fruits. Planting may be 9 metres apart in good soils in which the cashew grows to a large size. In inferior and rocky soils, spacing may be 5 metres. The first fruits may be gathered in 4 years. An eight-year old tree may be expected to give the full yield. Young trees produce flowers from November-February and fruits in March-May. In old trees, fruits are borne in November-January. The tree is short-lived beginning to die back in 15-20 years, exuding a gummy substance. 100-200 kgs. of fruit may be got from a tree. This is a good tree, for wasteland plantation. It is attacked with very few pests. There is a large export trade of the nuts to America and Europe as they are used as a substitute for almond in confectionary.

Ananas sativus. Pine Apple. (*Bromeliaceae*). Vern. 'Anras', 'Ananas'.

Perennial plant, $\frac{1}{2}$ to 1 metre high, with a very short stem hidden over by a rosette of long, narrow, stiff, fibrous leaves, usually spined. The root system is poor, as a result of which, the plant has a tendency to fall over when grown up. The fruit is borne on a stalk, which is an extension of the main stem, in the centre of the plant. It is a syncarp,

peculiar in structure, being made by a fusion of number of ovaries in a head of flowers borne in the axils of bracts. While these are included in the multiple fruit, there are others, which form ultimately the 'crown' of the fruit, the small tuft or rosette of leaves above it.

A native of Tropical America, the Pine Apple thrives in warm humid climates, where it is grown commercially. It will grow in arid regions also, when irrigated. Very strong sunshine where temperature is high is undesirable, so also complete shade. Largely grown in many parts of the West Coast, Cochin and Travancore in South India, in Assam, Bengal, in certain parts of United Provinces, Burmah and Ceylon.

In home gardens, rows of Pine-apple plants along a walk or path are attractive. They are also suited for planting in groups of 4 to 6 plants under fruit and other trees where they would receive the necessary shade. Pine-apple can be grown in different kinds of soil, provided it is well drained. It prefers one with an open texture—a rich loamy soil with a large amount of humus in it.

Plants are best grown from 'suckers' or 'ratoons', which are produced from the axils of leaves near the roots or from below the soil. These bear fruits in 15-18 months after planting. 'Slips', the shoots borne on fruiting stems below the fruit, and 'Crowns', the tops of fruits, take much longer time—22-36 months—to bear after planting. After removing the lower leaves from the suckers they are left in a cool place for 3-4 days to form a hard callus. Planted fresh, they are liable to rot.

Planting is made 5-12 cms. deep in rich well prepared ground, firming the soil round the base of the plants and taking care to prevent the soil from getting to the hearts—the hollows in the middle of the rosette of leaves. Usually for large scale planting, trenches are made $\frac{1}{2}$ metre and deep and 1 metre apart and filled with soil enriched with heavy applications of manure and bonemeal. A small ridge is made in the middle of each trench and the suckers are planted in it $\frac{1}{2}$ to $\frac{3}{4}$ metres apart, trimming off the lower leaves. Irrigation is done once in 7-10 days. The ground is kept free from

grass and weeds. When the suckers have taken a grip of the soil, about 4 months after planting, 15 gms. of bonemeal and 30 gms. of oil-cake powder may be applied round each plant. In the absence of the above, organic manure and wood ashes may lightly be stirred into the soil in the trench. Fruit buds appear in 10-12 months, when the soil may be top-dressed again with manure. Fruits take about 3 months to develop and ripen. As they are liable to be attacked and spoiled by bandicoots, rats, squirrels and bats, it is advisable to cut them with a portion of the stalk, when they begin to turn yellowish at the base and allow them to ripen indoors. But, too early cutting renders them insipid and wanting in flavour. Pine Apple is rich in vitamins A, B and C, as well as in minerals and acids of dietary value. After a crop, the plants which have fruited are cut back to one or two healthy suckers at the base for the next crop. Manuring and watering are done as before. It is not desirable to continue the plants in the same plot for more than 3 years.

The best varieties to grow are: (1) Smooth Cayenne, also known as Kew or the Giant Kew. Grows tall with spineless leaves, producing massive large fruits weighing 12 to 40 kgs.. (2) The fruits of the Queen are small but very tasty with an attractive flesh colour. (3) Red and Yellow Mauritius produce fruits weighing 7 to 12 kgs. and are only next to the Queen in point of flavour and sweetness. (4) The variegated leaved Pine Apple is a pretty ornamental plant for pot-culture. The fruit is small and edible.

Anona squamosa. Custard Apple. (*Anonaceae*). Vern. 'Sareefa', 'Seethaphal', 'Duranji'.

Also known as Sweet-stop or Sugar Apple. A semi-deciduous hardy small tree, 2½ to 4 metres high. The fruit is heart-shaped or round, yellowish green or light purplish brown in colour, there being two well marked varieties. It weights 170-340 gms. has a rind with a tuberculated surface, looking as though made up of a number of scales. The pulp is sweet with a slightly acidulous flavour and in it are imbedded in separate segments, as many as 20-35 seeds, from which the plants are raised. They fruit in 3-4 years. Grafts by enarching good variety of Seethaphal on stocks of

Ramphal bear early and are more desirable. Planted 3 to 4 metres apart.

A native of Tropical America and widely distributed in warm sub-tropics also. Cannot thrive where winter is severe. Known from early times in India, thriving best in a relatively hot and dry climate, such as that which obtains in the low-lying interior plains. But, it grows and fruits at elevations of about 725 metres and on humid hill slopes. It is equally tolerant of soil conditions and can be grown in rocky, sandy and rich loamy soils. Good drainage is essential.

For lack of pollination, which is a family tendency, a tree may not fruit freely, in which case, hand pollination will be helpful in inducing setting of fruits. They are in season from August-December. They are best eaten out of hand. An excellent jam is made out of them. Fruits, if left too long on the tree, split open and decay and are also eaten by squirrels and rats. Best picked before they burst, when they are still firm and the skin between the segments is turning creamy-yellow and begins to crack. After harvesting, they are kept by for 3-5 days for softening.

The leaves are often used for making a decoction to be applied against certain insect pests as *epilachna*, mealy bug, etc.

Anona muricata. Sour-sop. (*Anonaceae*). Also another small tree of Tropical American origin, bearing large fruits weighting up to 14 kgs. They are ovoid or heart or kidney-shaped, and have a white flesh which is somewhat cottony in texture, juicy and highly aromatic. The flavour suggests a combination of the Pine-apple and the Mango. But the fruit is not relished by many and is only used to make refreshing drinks. The tree yields very sparsely, about a dozen fruits a year. It is more tropical in its requirements, and is more tolerant of moisture than the Sugar-apple and can be grown in moist low regions. Yields in 4-5 years from seed.

Anona reticulata. Bullock's Heart. (*Anonaceae*). Vern. 'Ramsita', 'Ramphal'. Another Anonaceous fruit which is inferior to the Custard apple and the Cherimoya. Also a small tree, indigenous to Tropical America, with heart-shaped or oval fruits, slightly larger than those of the Custard Apple,

with a smooth reddish-brown or yellowish surface divided by, impressed lines into broad areolae. The pulp is white, granular, sweet and custard-like. The tree prefers deep rich soil, with plenty of moisture. Is not so partial to a dry climate as the Sugar-apple. Thrives up to 750 metres.

Anona cherimolia. Cherimoyer. (*Anonaceae*).

It is a member of the Custard apple family, little known but bearing delicious dessert fruits, which are generally heart-shaped, irregular in form, 10 to 12.5 cms. in diameter 2 to 5 kgs. in weight, and greenish-yellow in colour. The flesh is white, juicy, sub-acid, and of butter-like texture. The fruit is superior to the Custard-apple in point of flavour but not so sweet. A small erect or somewhat spreading tree, 4 to 5 metres high, with handsome foliage and scented flowers. A native of the highlands of Equador and Peru in S. America, Essentially sub-tropical in requirements, thriving only above an elevation of about 900 metres, in places where the climate is cool and relatively dry. Rich loamy soil gives best results. Not a free yielder, as pollination is scanty; bears only about a dozen fruits a year. Propagation from seed is not recommended. Secure plants grafted on *Anona reticulata*. Bears in about 5 years after planting.

Artocarpus incisa. Bread Fruit. (*Urticaceae*). See page 258.

Artocarpus integrifolius. Jack. (*Urticaceae*). Vern. 'Kathal', 'Pala', 'Halasu'.

A big, long-lived hardy tree, growing 10-12 metres high, with a good spread, bearing one of the largest fruits in existence, on its trunk and older branches and sometimes at the base of the trunk or even underground. It is a native of South India and Malaya and is best suited for moist or semi-dry places up to an elevation of 500 metres, though it grows in humid parts on hill slopes even up to an elevation of 1,100 metres. Though it grows in any ordinary soil, it attains perfection in deep red loamy soil. In places with scanty rainfall, irrigation is necessary for a good yield.

The Jack is one of the most popular trees on account of its varied uses as the Banana and the Coconut. The leaves are stitched into plates for dining; the wood is of splendid

quality, useful for making furniture and house buildings; the raw fruits are used as vegetable and the flesh of ripe fruits is exquisitely delicious, as though soaked in honey; the seeds are the poor man's food, rich in starch and good for eating, roasted or cooked.

There are several varieties of local importance varying in size and quality. Fruits of some varieties are reported to weigh up to 175 kgs. Propagation is from seeds, plants taking 6-10 years for fruiting. Grafts (enarched plants) fruit in 4-5 years. For propagation, collect seeds from a variety with a fruit which has fairly thin rind, large fibreless brittle pulp of honey-like sweetness and small seeds. Plant 10-11 metres apart. Blooms appear in winter and the fruits are ready in the hot weather—March to May and June. Some trees produce only a few fruits, even less than a dozen, while some are known to produce as many as two hundred.

Artocarpus nobilis. (Vern. "Kottai Seeme Pala") is very much like the Bread Fruit tree but the fruits have some round white seeds. It grows to noble proportions, often growing 10-12 metres high with large leathery leaves. Best suited for moist low country up to an elevation of 500 metres. Raised from seed.

Averrhoa Carambola. Karambola Tree. (*Geraniaceae*). Vern. 'Komrac', 'Tamatanga', 'Kamranga'.

An ornamental tree growing to a height of 5 to 7½ metres, with beautiful evergreen foliage and clusters of pale purplish or white flowers, borne in short racemes from the bark of the old and young branches. The fruits are translucent, yellow or pale golden brown in colour, are elliptic in outline with three to five ribs running longitudinally. The fruit "contains a clear watery pulp, astringent when green and tasting like sorrel or green gooseberries, but pleasantly acid when ripe, or even sweet, with an agreeable fruity flavour, and a strong perfume like that of quince". When fully ripe, it may be eaten fresh. When slightly unripe, stewed or made into an agreeable jelly or used in pickles. The juice contains potassium oxalate, which removes stains from linen. The tree is tropical in its requirements and prefers a warm moist climate. It may be grown throughout India in regions

where is no frost. It thrives in deep rich soil but it can grow well in any soil with good drainage. Seedlings take about 5 years to fruit. Young plants are delicate and need attention. Secure grafts or layers from the sweet-fruited variety. Plant 5-7½ metres apart. Fruits are produced throughout the year, but mainly in the cold and hot weathers. The tree is believed to be a native of the Moluccas but is known in India especially in Malabar, from a very long time.

Averrhoa bilimbi. The Cucumber Tree. The Bilimbi. (*Geraniaceae*).

Allied to the Carambola, it is a small ornamental tree, about 5 metres, high producing sour fruits resembling small green cucumbers, about 7.5 cms. long, 2 cms. in diameter and they are borne on the trunk and the oldest branches in clusters; are used for pickling, for making preserves and jams and cooling drinks; used in certain places as a substitute for tamarind. More tropical in nature than Carambola. Thrives up to about 900 metres raised from seed or by layers.

Carica papaya. Papaya. Papaw. Tree Melon. (*Passifloraceae*). Vern. 'Papay', 'Pappali'.

A well known quick growing ornamental herbaceous tree, which requires no description to introduce it. On account of its ornamental value and its utility, it is grown with advantage even in small gardens. Though originally it is supposed to have come from Tropical America, it has become indigenous to India and Ceylon. Here also, as in its native home and elsewhere, it is of great value to the poorer classes, furnishing them an article of diet, rich in vitamins A and C. Higgins and Holt say of it, "Excepting the banana, there is no fruit grown in the Hawaiian Islands that means more to the people of this territory than the Papaya, if measured in terms of the comfort and enjoyment furnished to the people as a whole". Unripe fruits are cooked and used as vegetable like pumpkins. Ripe fruits are excellent for dessert and breakfast. They are refreshing, sweet and pleasant, and digestive. Papayas are grown commercially for the extraction of pepin, a digestive ferment like pepsin, from the unripe fruits. This property of the fruit and even the leaves is

known and made use of to soften meat in cooking it, by wrapping it in a leaf or putting a piece of unripe fruit along with it.

The tree is tropical in its requirements but adapts itself to a wide range of territory and thrives up to an elevation of 1,000 metres and more, if frost free. Shelter from winds is necessary. With proper attention to drainage, Papaya will grow in any kind of soil. But, in deep rich loamy soil, best results are obtained. Easily raised from seeds, which should be collected from sweet large well flavoured fruits with small cavity. Prefer oblong to round fruits, as they are produced from self-pollinated flowers. Wash the seeds in water, gently rubbing them to remove the gelatinous covering and dry them in shade for 5-6 days and sow the thinly, 5 cms. apart and 1 cm. deep, in seed-pans or nursery beds. They germinate in about 20 days. When the seedlings are about 7.5 cms. high, transplant them in prepared beds without disturbing the roots, 15 to 20 cms. apart. The seeds are best sown in prepared beds, if facilities are available, 15 cms. apart. Protect the bed and seedlings from severe sun and rain. When they are 20-30 cms. high, water the bed well and remove the plants carefully with least disturbance to roots and plant them in pits, made ready for them. Let the pits be $\frac{1}{3}$ to $\frac{1}{2}$ metres deep and wide and $2\frac{1}{2}$ to 3 metres apart. Papaya is a rapid grower and a gross feeder. So, manure liberally and water regularly for best results. Excess of moisture over a prolonged period at the roots and in contact with the stem causes stem and root rot. To avoid this, slope the soil in the basins away from the stem. Flowers are borne in about 5 months. The male plants bloom earlier than the hermaphrodite and pistillate flowering types and are distinguished by the cup-shaped flowers which are borne on pendant racemes, which are $\frac{1}{2}$ - $\frac{3}{4}$ metres long. Male trees do not produce fruits and so remove them. Experiments have shown that some male trees when headed produce female flowers and fruits on new shoots that come up. A male tree need not be kept on for supplying pollen for fertilizing female flowers. Researches have shown that seedless Papaya fruits can be obtained without pollination. Fruits are ready

in 10-12 months after sowing. The trees become old in 5 years, after which they are not worth keeping. Papaya is free from disease. Very rarely, it is subject to a fungus disease, which shows itself by the leaves drooping down and ultimately drying and falling off, leaving the stem naked and to die in a short time. Collect the affected leaves and burn them to prevent the spread of spores. Pick fruits when they show colour, or they are destroyed by birds, squirrels and civet cats. Monkeys are fond of young leaves and fruits. Thinning is necessary for securing large fruits.

Honey Dew, Washington and Singapore or Mammoth Java are favoured varieties, well flavoured and delicious. In a mixed plantation, it is not possible to raise plants true to type, on account of cross-pollination. It is possible to propagate from cuttings and grafting by enarching good varieties but on account of the low percentage of success and limited availability of cuttings or scions, large-scale propagation by these methods is not possible.

Carica candamarcensis. The Mountain Papaya. (*Passifloraceae*).

A native of the highlands of Central America, suited for growing at elevations of 1,800 metres and above. It grows 2-2½ metres high, resembles the Papaya in form, the leaves and the fruits being smaller. The fruits are sweetish and are best eaten with a little sugar as they are slightly acid. They make good jams and jellies and like the Papaya are considered good for dyspepsia.

Citrus Fruits.—Orange, Lemon, Lime, Pummelo, Grape Fruit, Sweet Lime, Citron etc. (*Rutaceae*).

Evergreen small trees or shrubs with polished green foliage, bearing fruits used for various purposes. Though of tropical origin, they are accommodating in their requirements of climate, thriving from sea-level to 1,000 metres and more, in places free from frost, particular kinds and varieties being better suited than others to particular soils and climatic conditions, as influenced by rainfall, humidity, altitude and temperature. Citrus trees, as a class, are very sensitive to adverse soil conditions. Heavy moist soil, very light soil and soils with an impervious layer of rock below are not suitable.

Good drainage is absolutely necessary. They suffer in too alkaline or too acid soils and are subject to diseases caused by deficiency of certain minerals as iron, boron, copper, zinc etc., in the soil. Unsuitable irrigation water containing an excessive concentration of soluble salts, especially chlorides, is highly injurious.

Planted 3 to 8 metres apart, according to the growth they make ultimately. Pits, $\frac{3}{4}$ metre broad and deep should be made and filled with good soil enriched with at least 4 large baskets of well decomposed farm-yard manure. The plants should not be set deeper than they stood in the nursery row or pots. Stems of newly planted trees should be whitewashed and should be shaded from severe sun in addition to prevent sunburn, till they form heads with protective foliage. The young plants should be watered regularly twice a week in summer and once a week at other times, in the absence of rains. The soil should slope away from the stem to the edge of the basin to prevent accumulation of moisture near the stem. The basin for watering should be widened as the tree grows. For a six-year old tree, it may be made $\frac{3}{4}$ to $\frac{3}{4}$ metres away from the stem and extend 15-30 cms. beyond the actual spread of the tree. As Citrus trees are practically active throughout the year, they require an adequate supply of water. The soil below 20-25 cms. of the surface in the basin should never be allowed to get dry. The basins should be kept free from grass and weeds.

No pruning is necessary except by removal of overcrowding branches and dead and diseased parts. Water shoots should be cut off clean, as also shoots arising from the stocks below the point of union of stock and scion and the suckers from the base. It is usual to head back lanky plants to 45-60 cms. before planting for producing low headed trees.

It is difficult to lay down any definite rules for manuring Citrus trees, applicable to all soils. Manurial practices vary in different localities. In this country, artificial fertilizers are avoided and liberal applications of organic manure and leaf mould are given before the rains commence. Green manuring is done in addition in commercial plantations. A dressing of 5 cms. thickness of well decomposed manure, with 2 to 4 kgs.

of bonemeal and 4 to 6 kgs. of oil-cake dug into the basin once a year in July–October would probably supply all the manurial needs of trees, more than four years old. As Citrus trees require more nitrogen than other kinds of trees, if sufficient quantity of farm yard manure is not available, a total quantity of 9 to 12 kgs. of ammonium sulphate for a tree for a year may be applied at intervals of 3 months in small doses. 4 to 6 kgs. of potassium sulphate and 9 kgs. of superphosphate applied also in small doses would supply the other essential elements. Deficiency of iron in the soil is indicated by the leaves becoming small and almost white and falling off and all growth coming to a stand-still with a chlorotic appearance. Spraying with .0001% solution of ferrous sulphate is recommended for results, which may however be only temporary. Chlorosis of a different type is caused by deficiency of manganese. Zinc deficiency is very common and is followed by a typical yellowing of the leaf-blade, the veins and midribs remaining green, as a result of which the yield is very much reduced and the quality of fruits also impaired. On account of the low vitality caused by the affection, some shoots also die-back. A solution of zinc sulphate and quick lime made by adding zinc sulphate, and quick lime in the proportion of 11 kgs. of each to 225 litres of water sprayed periodically on the affected trees keeps the disease under control. Die-back of a severe type is caused by copper deficiency. Drooping irregular shaped leaves and exudation of gum from twigs and fruits are preceding indications. Control, if at all, is effected by spraying with Bordeaux mixture.

Whereas some Citrus kinds as Lime flower throughout the year, most of them have two or three distinct flushes of growth and periods of blooming. 8-10 months or more are required for collecting the fruits. To induce greater production of flowers and fruits at particular desirable times of the year, in Central and Western India, watering is stopped to the trees for about a month and a half; 7.5 to 15 cms. of soil is removed in the basin, exposing the roots; and thin fibrous roots are clean cut away and the soil mixed with manure is returned to the basin after 4-5 days; then irrigation

is done lightly; after 4-5 days after the first irrigation, the basin is irrigated heavily at intervals of 7-15 days. Fresh shoots are produced with flowers. The above-mentioned practice involves a certain amount of root pruning and forcing the tree, which is harmful as it would shorten its life, if persisted.

Though most species of Citrus produce seedlings which may yield fruits uniform in quality and not very often different from those of the parent plant, there may however be variations which may not be quite desirable, as for instance, the fruits may be of inferior flavour or quality or undersized or the tree may not be prolific or not make good growth. Though seedlings are supposed to make more vigorous growth than budded plants or grafts, they take longer to bear than the latter and are more thorny. Further, they may not be suited to the particular soil conditions. Hence, only budded or graft plants, are favoured for planting. Scions should be taken from specimen trees from bearing branches and budded on stocks best suited for the particular soil. Root and trunk diseases are avoided by the use of disease-resisting stocks.

Pummelo stocks are best suited for general use but they are seldom used by nurserymen. Rough Lemon (Jamburi) stocks are most commonly in use. They are resistant against foot-rot and gummosis and are particularly suited for dry soils, sandy or gravelly soils, needing frequent and copious irrigation. Sour Orange stocks are also resistant to foot-rot and gummosis and are suited only for comparatively wet soils. Plants on them suffer less by protracted drought than those on Rough Lemon. While Rough Lemon takes successfully a wide range of Citrus species, Sour Orange does not. Lime, Kumquat and Loose-skin oranges are reported to be failures on Sour Orange stock.

For propagation, sow 7.5 cms. apart and 1.25 cms. deep in nursery beds, large plump seeds collected from ripe fruits, washed free from adhering pulp and dried off in shade for a couple of days. When the seedlings are $\frac{1}{2}$ cm. thick and 15-20 cms. high, lift individually robust plants with as many fibrous roots as possible and plant them 22.5 to 30 cms. apart

in rows 45-60 cms. apart in well prepared ground. As the plants grow, keep clean the lower 25 to 30 cms. without side growths. When they are 1.25 cms. or a little more in thickness and 12-18 months old, bud them not more than 15 cms. above ground level with select scions. Shield budding described in pages 100-103 gives best results.

Budding may be done at any time of the year. The percentage of success is low, if it is carried out in either too prolonged hot or wet weather. Select plump axillary buds without thorns, from round firm one year old wood, which is green and dotted with grey streaks. Cut the shield with a very thin piece of wood to be rigid enough for insertion, into the stock without injury. The bud begins to grow in about a month. After it is united well with the stock, remove the wrappings and clean cut off the stock 5 cms. above the point of insertion. When the bud has made a growth of 22.5 to 30 cms., cut away the remainder of the lopped stock smoothly just above the union. Stake the growth and train it to grow upright. Top the plants when they are 45-60 cms. high. Lift only robust plants with good ball of earth for planting.

The following are the more important insect pests:—(1) Larva of the Citrus Butterfly, called the 'Orange dog' by some, is very destructive to young plants in seed-beds and in the orchard eating voraciously causing defoliation. The butterfly is about 7.5 cms. across, bluish green in colour and is easily recognised by yellow markings and two dark eye-like spots on the hind wings. It lays pale yellow eggs of the size of a pin-head in small patches on young foliage. They hatch into tiny caterpillars, which look like bird droppings, as they become big. They are slimy and dark brown in colour with creamy white sloughy streaks. Later, they become dark green blending with the colour of the foliage and remaining unnoticed, but for their droppings. For control, adult and young larvae should be collected and destroyed, as also the egg clusters. (2) Citrus stem-borer (*Chelidonium Cinctum*) is a serious pest, more prevalent in places higher than 250 metres above sea-level. The adult beetle, lays a small egg at the axils of terminal shoots about the month of June. The egg, on hatching produces a very small larva in about a

fortnight, which makes a semi-circular cut and bores upwards when the shoot withers. It should be pruned away at sight. If neglected, the larva begins to come down and bore downwards through the pith of the shoots and branches, making a number of holes about the size of a pin-head for ventilation and for throwing out the saw-dust like powder. The larva increases in size as it continuously devours the central part of the branches and by about February next is just 2.5 cms. or more in length. By this time, the larva would reach the ground level boring down the stem throughout. It builds a nest for itself, plugging the top and bottom of the tunnel it has made, after making a big enough hole for it to escape as an adult beetle in course of time, for breeding and thus repeating the insect's life-cycle. This borer attacks all Citrus kinds. *Murraya exotica*, the China Box, serves as a host plant for it. Small affected branches may be pruned away, larger branches may be treated with the chloroform and creosote mixture as suggested in page 163. If the trunk is too far attacked up to the roots, it may be too late or save the tree. (3) Scale insects, such as brown and green bugs, often with an army of red ants to help them, (4) Black and other aphids are sometimes found clustered on the tops of young shoots. (5) Leaf miner, a tiny caterpillar boring into the tissue of the young leaf, causing it to curl and fall off ultimately, is a minor pest. (6) Mealy bug and a similar cottony-cushioned scale insect are pests in some regions. (7) A moth sucking the juice from fruits through its proboscis is common in certain localities, causing the fruits to rot and fall prematurely. The fruits are often protected by cheap palmyra baskets. The moths may be attracted to strong lights and killed. (8) For the fruit moth and the fruit fly, the maggots of which feed inside the fruits, as in the Mango, a deterrent spray of crude oil emulsion may be tried. See Chapter XI for remedies for the above and other pests.

Among diseases of Citrus trees, the worst is die-back. Gummosis is another serious trouble. Canker and scab appearing as an orange-coloured rust and spreading on parts of foliage and green shoots, weakening and deforming them

and bringing on die-back ultimately are other diseases. Citrus suffer, as mentioned already, from diseases caused by deficiency of certain mineral ingredients in the soil. The most prevalent is the 'Mottled leaf disease' due to zinc deficiency. Blight or mildew is also common. Collar and root-rot is brought on by bad drainage, resulting in rapid death of trees. Sooty mould is very common. For all these and other diseases, consult Chapter XI.

Due to the existence of a very large number of species and varieties and intermediate forms, Citrus classification has been very difficult and confused. The following are the more important Citrus Fruits with their botanical names, mostly according to H. H. Hume:—

Oranges. There are three types of oranges, each with several varieties suited for particular climatic and soil conditions. (1) The loose skinned or loose jacket oranges (*C. nobilis*) called the **Mandarin Oranges**. The skin separates from the pulp easily and also the sections of the pulp from one another. More favoured as dessert fruits and for eating out of hand than the Sweet Oranges on account of their distinctive sweet flavour which is also pleasantly acid. The leaves are generally small and pointed with a characteristic scent. The best known variety in S. India is the Coorg Orange. It is grown successfully at elevations of 400 metres and more in comparatively humid regions or with fairly heavy rainfall as Coorg, in parts of Mysore State, Nilgiris, Shevroys and Palanis, Yercaud Hills. The Nagpur or Santra Orange enjoys a popularity next to the Coorg Orange. It is largely grown in Central Provinces and Bombay. Though it is best suited for a hot and dry climate, it grows and fruits in places where rainfall is as heavy as 250 cms., if the soil is rich and well drained. It does well up to an elevation of about 750 metres. Tangerine, Satsuma, and King are other kinds of Mandarin Oranges, which can be grown in places with an equable climate, above an elevation of about 500 metres. (2) The tight skinned or **Sweet Oranges**. (*C. sinensis*). There are several kinds, difficult to be classified. In all, the skin adheres to the pulp and does not peel off easily.

The sections of the pulp do not separate as easily as in Mandarins. The best known variety in S. India is Sathkudi, in a number of its own varieties, Also known as Satgar, Nagari or Chinese orange. The best variety of Sathkudi orange is large and spherical in shape, has a thin yellow or orange yellow rind, is rich in juice which is sweet and of very good flavour. The tree thrives in the hot plain country and is grown on a large scale in Chittoor, Kurnool, Cuddappah, Madura and Tinnevelly districts of Andhra and Madras States. The Batavian orange which is grown commercially in the East Godavari district seems to be an inferior variety of the Sathkudi orange. Mosambi or the Mozambique orange is grown near Poona and other parts of the Bombay State and in Kurnool district of Andhra State. The fruit is oval-shaped and orange-yellow in colour. The skin is more difficult to peel and the segments are more difficult to separate than in Satgar orange. The juice, though sweet is comparatively insipid and wanting in flavour. The Malta or Blood orange is grown in Punjab. The tree is dwarf and bears well, medium-sized fruits with reddish flesh or streaked with ruby colour. This variety is not suited for S. India. Of the imported varieties of the Sweet Orange, the best is Washington Naval Orange. It is known as the 'King of Oranges', possesses a fine flavour and has splendid keeping qualities. The fruit is distinguished by a navel-like mark on the apex. Valencia Late is a variety which is superior to the local Mosambi. Excepting Sathkudi, all the Sweet Oranges mentioned above are comparatively short lived, Mosambi being the most liable to die-back and gummosis. (3) The **Sour Oranges** (*C. aurantium*), known also as Bigarade or Seville Oranges. The trees are hardy and long-lived. Fruits resemble those of the Mandarin Orange. There are two types as represented by the 'Herale' or 'Jatinarti' and the 'Kichili' of S. India, in both of which the pulp is sour. In the former, it is slightly bitter too. The fruits of both kinds are used for pickling. Seville orange is used for making marmalade. It is distinguished from sweet varieties by its broadly winged petioles, the distinctively different odour of the essential oil, the hollow centre in the fruit,

the taste of the fruits and the strong resistance of the tree to diseases of many kinds.

Pummelos. (*C. maxima*=*C. decumina*=*C. grandis*). Vern. 'Papnas', 'Bombalimas', 'Chakkotri'. Trees need planting 6 cms. Fruits are large to very large, globose or pear-shaped, white or pink fleshed and borne singly. Leaves are dark green, pubescent, leathery and with large wings on the petioles. There are some good local varieties. Select those with sweet and juicy pulp, as that from Devanhalli in Mysore State. Inferior varieties are sour and bitter and are not worth growing. Pummelo is a hardy tree thriving up to an elevation of about 1,250 metres. Layered plants do very well. **Shaddocks** are imported varieties of Pummelo, less hardy and shorter lived in our climate and very often of inferior quality.

Grape Fruits. (*C. paradisi*). Called also Pomelos. The name, Grape Fruit, derived from the fact that the fruits are borne in grape-like clusters of 3-4 to a dozen. They are smaller than Pummelo, have a thinner, rind, are more juicy and have a different flavour. According to Hume, "the grape fruit stands without an equal as a breakfast fruit, for it is an excellent appetizer and stomachic. The ideal fruit should have the bitter taste rather pronounced; the flavour should be characteristic—a pleasant indescribable blending of bitter, sweet and acid". The leaves of the Grape Fruit are not pubescent. They are lighter in colour, slightly smaller than those of Pummelo. Grape Fruit trees are shorter lived in our climate than Pummelo. The best varieties tried here are Marsh's Seedless, Triumph, Duncan and Mc.Carty.

Tangelo is a hybrid between the Grape Fruit and Tangerine orange. The tree has the appearance of a small Grape Fruit tree; though not commercially grown, is well worth a place in home garden. The variety 'Thornton' is the best known. The fruit is orange-coloured, oblate and resembles that of a Grape Fruit in appearance; the surface is a little rough; skin is thick but is easily removable as in Tangerine; the fruit has orange coloured pulp, is juicy with a distinct flavour—mildly sub-acid with no indication of bitterness.

Limes. (*C. aurantifolia*). Vern. 'Nimbu', 'Elumichai' 'Nimbe'. Small bushy trees or large shrubs with sharp stiff thorns producing in plenty very useful small, oval or round fruits, with thin yellow or yellow-green rind. Most tropical of Citrus trees, thriving best below an elevation of 250 metres but doing well up to an elevation of about 900 metres. Grow without much care. Planted 2.5 to 4 metres apart. Seedlings produce strong plants beginning to fruit in 5-6 years and living for about 15 years. Budded plants on Lime stock fruit earlier and are superior to grafts on Rough Lemon stocks. The round fruited variety is the best commercial variety extensively grown in parts of S. India. It is known as Kagzi lime in N. India. There are varieties of the fruit with variations in size and in thickness of the rind. There is a seedless variety also. The longish fruited variety known as the 'Umbu Nimbe' or 'Kodi Elumichai' has spreading branches. Tahiti lime is an imported variety, less thorny than the local variety; the branches grow and droop down; the fruits are large with plentiful juice, broadly oval and produced freely but not so prolifically as in Kagzi lime. Seeds are few or nil.

Sweet Lime. Vern. 'Sakkar limbu', 'See nimbe'. A distinct variety bearing fruits of the size of a small orange with a pale smooth yellow rind. The juice is insipid, mildly sweet without acidity and lacking in flavour, used for making a refreshing drink, slightly salted or sugared. The tree is large and spreading with foliage of lighter colour than in other Citrus trees, is hardy and very fruitful.

Citron. (*C. medica*). Vern. 'Mahalung', 'Madavala', 'Turanj'. Large shrub or small tree with a short stem and straggling branches. Leaves are large, glabrous, and tinged purple, when young. Fruits are large, 15 to 25 cms. long and about 5 cms. in diameter, frequently very rough; they have a thick, soft and warty rind which is the part used for making sweets, as candied peel and in confectionery; juice sacs are small and slender and the juice, scanty, acid and bitter. They are valued for their medicinal properties. Not grown commercially but worth a place in the garden. Secure well grown seedlings which bear in 4-5 years. Layered plants

also do very well. There is a small variety bearing smaller and smoother oblong-oval fruits with rind less thick, which is not so useful as that of the large variety.

Lemon. (*C. lemonia*). Small trees yielding heavy crops of fruits, very much used like Limes. Citrate of lime, citric acid, lemon juice, lemonade, lemon oil and candied lemon-rind are articles of commerce from lemons. The fruits are 2-3 times larger than Limes, are roundish or oval or oval-oblong in shape with a terminal nipple. They are produced throughout the year as in Limes. As Lemon trees are more hardy and freer from many of the diseases to which Limes are subject to, they are entitled to be grown more extensively than at present. Most of the varieties are best grown at elevations of 250-500 metres and more and they have proved themselves more adaptable to climatic and soil conditions than Limes. Some varieties such as Lisbon which are inclined to grow tall bearing fruits only at the top portions of the branches as they age are headed back profitably, when they have become too leggy. There are several varieties. The following are tried with success in this country:—(1) A non-descript variety which may be called the Seedless Lemon and which may be easily grown from layers is a large shrub producing early large oblong-oval fruits, 10-15 cms. long and 5-10 cms. across, rich in juice, deserves a place in every garden. Lemons, Lisbon, Eureka, Villa Franca, are well known varieties with a rich flavour introduced into this country. The Italian Lemon is also a very promising variety with large, juicy, roundish-oval seedless fruits. The 'Jamburi'—Rough Lemon—is a hybrid Lemon with rough and somewhat loose-skinned fruits, different in appearance from Lemons. It is extensively used as stock for budding other varieties of Citrus. The juice though not so well flavoured as the true Lemons is useful.

Gajanimma; a hybrid also known in vernaculars as 'Kadarangai' or 'Dodda herale' in S. India grows into a hardy tree, though susceptible to gummosis, producing large fruits, rich in sour juice and useful for pickling.

Kumquats. (*C. japonica*). Called Fortunellas also, after Robert Fortune, who introduced them first to Europe. Ever-

green, well-branched, small trees or shrubs, clothed with dense foliage and bearing oval or round fruits—there being two varieties—which look like miniature Mandarin oranges, practically throughout the year. The rind is sweet and edible and the juice, which is both sweet and sour, is useful for making a refreshing drink. The fruits are reported to make excellent preserves, marmalades, jellies, and to be suited for candying. The plant is of great ornamental value, suitable for growing in tubs or large pots or for planting on lawns.

Cocos nucifera. Cocoanut Palm. (*Palmaceae*). The Cocoanut is so well known and so very popular on account of the several uses to which its several parts are put to that it needs no elaborate description. Tropical in its requirements of climate, the Cocoanut thrives best in a hot and humid climate near seaboard. Grows from sea-level to elevations of about 900 metres in S. India and about 500 metres in Ceylon. There are few or no trees in N. India. Deep alluvial sandy-loam is best suited but it grows and yields fairly well in gravelly soil also.

Fruits are borne practically throughout the year, in spikes, a dozen of them bearing about 15 fruits in each. Some trees may bear more and some much less. There are several varieties, differing in size, shape and colour of fruits, thickness of husk and copra. The "King Cocoanut" is favoured for planting in home gardens for its additional ornamental value, though not grown commercially. Dwarf varieties from Nicobar bearing crowded numerous small or huge fruits in its spikes are introduced into many gardens. There are 4 to 5 different varieties. The tree begins to bear when it is 3-4 years old the first fruits being 1 metre from the ground; these varieties may be planted 3 to 4 metres apart, as it does not attain great size.

For propagation, collect 'nuts' from the mature large yielding trees, in which the fruit is large with thin husk and large nut with thick and sweet kernel. They must be well ripened on the tree, and about a year old with dried up skin and with only a small quantity of water in them. Lay them on their sides in a nursery bed filled with sand, and cover them with sand leaving the tops just visible. Put a

little common salt round the nuts in the sand bed to keep away white ants. In about 3 months, the nuts being to sprout and in about 10 months more, the seedlings are ready for planting. While lifting them, take care not to cut or damage the roots unnecessarily and not to separate the nuts from the plants. Make pits 4 to 5 metres apart for planting in a single row and 6 to 7 metres apart for group planting. The pits should measure at least $\frac{3}{4} \times \frac{3}{4} \times \frac{3}{4}$ metre. Planting should be deep and firm. For this purpose, fill the pits to only $\frac{1}{2}$ metre from the surface with soil mixed very liberally with sand and firm it all round the base of the plant, soon after planting. Water liberally once in 3 days. After the first year and up to 4 years, water once a week. Cultivate the ground in between the pits once in 6 months, digging up to a depth of 20 to 30 cms. cutting away all fibrous roots. Gradually cover the pits with soil mixed with old manure and wood ashes. Early sea-coast varieties begin to bear in 4-5 years after planting. Others take 6-8 years. During the first two years, only a few fruits set. With increasing age, the yield increasing reaching the maximum in about 10 years. As the fruit clusters are very heavy, it is advisable to support them with stout forked sticks with their pointed ends placed firmly against the stem at the base of the leaves. Guard against attacks of Rhinoceros beetles. (See page 162) It is usual to put some sand mixed with a little salt into the bases of the leaf-stalks to minimise attacks from them. Broad-mouthed pans containing rotting castor-cake placed near the trees attract the beetles, which may be collected and destroyed.

Cyphomandra betacea. Tree Tomato. (*Solanaceae*).

A small tree, $1\frac{1}{2}$ to 2 metres high, with large fleshy ever-green leaves. The fruits are egg-shaped, about 5 cms. long, and borne in clusters or two or more at the ends of the branches. The colour is either reddish yellow or deep purple, there being two varieties. The skin is smooth. In character, the fruits resemble those of the Tomato. They are sub-acid and succulent, enjoyable and refreshing, eaten raw or better still as stewed food. They are also used to make jellies and jams. The tree is raised from seeds, grows quickly, is ready

for planting out in about 3 months, and begins to bear fruits in 2 years, and remains productive for several years on the hill stations. At medium elevations of about 900 metres, it lives for five or six years. Suited best for elevations of 1,200 metres and above. Plant $3\frac{1}{2}$ metres apart and water liberally in summer and in the absence of rains. A native of Peru, where it grows from 1500 to 2500 metres above sea-level. This tree is now commonly grown on our hill stations. A pretty tree for planting on the lawn.

Diospyros Kaki. Japanese Persimmon. Date Plum.
(*Ebenaceae*).

A slow growing medium-sized deciduous tree with handsome leathery leaves. A native of Japan and China, where it is grown extensively, being considered one of the best fruits. The tree is usually dioceous, bearing male and female flowers on different trees and hence presenting difficulty in pollination. In the absence of male trees nearby, the female tree does not set fruits. The fruits are smooth skinned, shining, bright orange or pink or dark purple in colour, globular or pear-shaped, 5 to 7.5 cms. in diameter and weighing 90 to 180 gms. each. The pulp is soft, sometimes almost liquid, orange-coloured, sweet and has a pleasant flavour, which is suggestive of an over-ripe Apple with a little of the taste of the Melon. From unripe fruits, a preserve is made. The best varieties are dried by the Japanese and the Chinese and they are said to be equal to dried figs. The fruits ordinarily contain 2 seeds or more up to 8 but seedless kinds are also known. Secure seedless best varieties grafted on seedlings. The tree is sub-tropical in climatic requirements and is worth trying in this country on hill stations, where rainfall is not heavy. The tree is not exacting in soil requirements, does well in varieties of soil, with suitable drainage excepting the clayey soil. It loves moisture at the root and hence does best in dry regions with a good supply of water for irrigation. Distance apart for planting is 4 to 6 metres. Head the plants when about $\frac{1}{2}$ metre high for specimen formation.

Eriobotrya japonica, Loquat. See under Photinia.

Eugenia jambolana. The Jambon or the Jambul Tree.
(*Myrtaceae*). Vern. 'Jambon,' 'Nerale', 'Naval', 'Naka'.

A large timber and shade tree, native of Tropical Asia. The fruits are blue-black in colour and have a purplish juicy pulp enclosing a large stone or seed. The fruits are reputed for their cooling properties and for their anti-diabetic medicinal value. The tree is very hardy, requires very little cultivation and thrives best on river banks and such places where the water is within 3 metres of the surface. Secure grafts of superior kinds which bear large fruits, 2.5 to 4 cms. long and 2 cms. in diameter, with comparatively small seeds. Grows about 10 metres. Fruits available from June-August.

Eugenia jumbos. The Rose Apple. Vern. 'Gulab jamoon', 'Pannerale', 'Seeni jambo'.

An ornamental evergreen tree growing about 7 metres high with a spreading habit, bearing flowers with numbers of white long stamens and fruits about the size of small Limes. The thin pulp which encloses a polyembrionic large seed is sweetish in taste with a pleasant rose flavour. The tree is indigenous to India and Malaya and thrives in warm moist regions, as also in the cool dry sub-tropics if supplied with water plentifully. Best for avenues, for shade and fruit in gardens. Propagated from seeds. Secure grafts of best specimens. Fruits in April-May.

Eugenia malaccensis. Malay Apple. Vern. 'Malaya jam'.

A native of Malayasia. Very ornamental conically shaped tree growing 7 to 10 metres high and endowed with large leathery, shining, elliptic-oblong, acuminate leaves. Flowers are borne in clusters and they have numerous long rosy-red stamens, which when they drop down spread a bright carpet under the tree. The fruits are pear-shaped, white or crimson in colour, 5 to 7 cms. long and 4 to 5 cms. in diameter. The skin is thin and the flesh crisp, "apple-like", white, juicy, with refreshing sub-acid flavour, enclosing a fairly large seed. The tree is tropical in requirements and fruits best up to an elevation of about 600 metres in moist hot regions. Seedlings take about 8 years to fruit but layers or gooties fruit in 3 years.

Eugenia javanica. The Samarang Rose Apple.

A low tree with the trunk branched near the base and the crown widely branched, with leaves larger than those

in *E. jambos*. Fruits are rather bell-shaped, about 5 cms. long and white to crimson in colour having the appearance of smaller-sized Malay Rose Apple and having similar taste. Fruits borne plentifully from March-May. Thrives up to an elevation of about 900 metres.

***Eugenia Micheli* = *E. Uniflora*. The Brazil or Surinam Cherry.**

Indigenous to Brazil. Small shrubby tree branching close to the ground and bearing small dark green leaves. Attains a height of about 4 metres in good soil. Fruits resemble the true Cherries in appearance, are deep red in colour, about 2.5 cms. in diameter, flattened at the ends, round and ribbed, soft and juicy with a sweetish acid aromatic taste and good flavour. Excellent for jellies, preserves, or stewing and also for dessert. Fruits are resinous and pungent before fully ripe when they are scarlet in colour. Raise from seeds. Sow 5 cms. apart and transfer to nursery beds when about 7.5 cms. high. Plant out 3 metres apart. Remove all suckers. Water freely. Unless watered freely when the fruits begin to change colour, they do not develop in size. Suited for elevations of 400 metres and above. As the tree is hardy and bushes out freely from the base and stands clipping well, it is often used for forming live hedges in Hill stations.

***Feijoa Sellowiana*. (*Myrtaceae*).**

A hardy ornamental shrub with grey foliage, white and red flowers with gold-tipped stamens and edible fruits, which are oval or oblong in shape, dull green in colour with whitish bloom. The flesh is whitish, granular, jelly-like, a little sour and aromatic and contains several tiny seeds. Fruits may be eaten out of hand when fully ripe but best used made into jelly or jam. Seedlings bear in about 4 years. Suited for growing in Hill stations and at elevations of above 1,000 metres. Fruiting season is from September-December.

***Feronia elephantum* = *F. limonia*. The Wood Apple. The Elephant Apple. (*Rutaceae*). Vern. 'Vilam', 'Bela'.**

A good sized tree with sparse small foliage, growing to about 12 metres. A native of Ceylon and India. Can be given a place in a large garden for the fruits, which are of the size of a cricket ball, and have a hard woody shell

enclosing a mass of soft brownish mealy aromatic smelling substance which is sweet and acid when ripe. The fruit is cooling in property and has medicinal value. Thrives in dry as well as moist low regions. Propagated from seed.

Ficus carica....Fig. (*Urticaceae*). Vern. 'Anjur'.

A large shrub or a small tree, 3-4 metres high. A native of the Mediterranean region and Turkey. A fruit of the warm temperate zone but grows under a wide variety of climatic conditions standing winter temperatures as low as 20° F and summer temperature as high as 115° F. Places which get heavy rainfall during S. W. monsoon are not suited, as rain during ripening period is not conducive to ripening or good flavour. A comparatively dry locality with an ample supply of water for the fruits to grow and mature should be chosen for commercial plantations.

The Fig is hardy and longlived and grows in a wide variety of soils. Medium to heavy rich loam, well supplied with organic manure and retentive of moisture gives best results. The site should be exposed to sun and sheltered from strong winds.

The fruit is a syconium and botanically interesting. It has mild laxative properties and is reported to be rich in vitamins, A, B and C. The varieties are not standardised and those grown in India are almost all similar to each other, except in size. Certain varieties as that from Smyrna do not fruit due to difficulty of pollination on account of the absence in this country of the natural agent of pollination, a fly.

Propagation is from cuttings of well ripened shoots of the previous year's growth or even older wood. Pieces, 1 to 2 cms. in diameter and 20 to 30 cms. long, with short internodes and containing 3-4 plump buds are inserted in sandy soil, 20-30 cms. apart for rooting. Layered plants also do well. Distance apart for planting may vary from 2 to 4 metres according to the soil and the type of growing. A spacing of about 2 metres would be sufficient if the plants are grown as bushes, the shoots of which are headed back every year to two buds from the point of origin. Well shaped strong bushes are ensured thus. During the first

year, the plant should not be allowed to fruit. A straight vigorous shoot is allowed to grow about $\frac{1}{2}$ metre. of ripened wood. Then its top is pinched to encourage it to send out shoots from below, of which 3 or 4 are retained to form side branches. When these have grown 45 cms. of ripe wood, they are shortened to form some more shoots on each to form enough frame-work for the bush. Figs fruit on young wood and hence worn-out leggy shoots should be cut back for productivity. The Fig is deep rooted and drought-resisting. Nevertheless, it loves rich manuring and copious irrigation during growth and when bearing till fruits begin to ripen. 4-6 large baskets of well decomposed cattle manure for each tree should be lightly dug into the basin, once or twice a year, when the plants are still at rest after a crop and before pruning 'Poudrette', which is obtained by allowing night soil to decompose amidst layers of soil and wood-ashes for 9-12 months has given best results. Pruning should never be done during the growing season, as profuse bleeding would ensue and cause a setback in growth and health of the tree. The yield per year from a well grown shrub or tree is 150-250 fruits. By systematic treatment, two crops may be raised per year.

The Fig is remarkably free from insect pests and diseases. Stem borer is a common pest. Fig-rust, observed as small rusty spots on the underside of the leaves, is a common fungus disease, causing defoliation and reported to be somewhat controlled by dusting with sulphur.

Fragaria vesca. Strawberry. (Rosaceae).

A low herbaceous perennial, creeping on the ground and increasing itself by runners. Improved cultivated kinds are many and they are grown with success only above an elevation of about 900 metres. At lower elevations, the plants may be grown for a season only bearing inferior fruits lacking in flavour. The fruits are heart-shaped, 2.5 to 4 cms. long and 2 to 2.5 cms. in diameter, very juicy, pleasantly sweet and rose scented, from which the name 'fragaria' is obtained. The soil required is very rich loam. It should be dug up to a depth of at least 35 cms. and it should be well drained. A water-logged position is fatal to Strawberries. A warm



Plate 7 : POINSETTIA PULCHERRIMA DOUBLE

sunny aspect is best. Long beds 1 metre broad are made, manure is liberally dug into the soil, and healthy suckers or rooted runners are planted firm in rows, 45 cms. apart, with 35 cms. from plant to plant. Planting should neither be too deep nor too shallow. The crowns of the plants should be showing above the soil. Planting should be done with the help of a trowel, making large enough holes for spreading out the roots before firming the soil on them. The bed should be kept moist by irrigating it once in three days as the plants are susceptible to drought. If watering is done from above as with a watering can, care should be taken that the water is not poured on the plants, especially when they are in bloom. The soil near the plants if drenched well would moisten the soil under the plants by percolation. The only points to be attended to are periodical and careful hoeing only with a view to keep down weeds, removal of runners during the season of fruiting, and regular watering and feeding with liquid manure when fruits are forming. The soil should not be stirred at any time as the roots are on the surface and would get damaged. Weak doses of cow-dung water used as liquid manure are attended with beneficial results. Fruits are borne in April-May and the runners should be planted in September to December. Planting should be done on the hills from February to April. The beds need attention even after the fruits are picked. Neglect results in weaker crowns and poorer crops during the next year. About August, new roots are formed around the collar from the crowns and these are the roots which feed and sustain the plants next year. These roots should not be damaged while top dressing the soil in December for the crop in March-April. The beds need to be renewed every two years. Of the diseases, the 'rust' which is caused by copper-coloured spores is dangerous. The only remedial measure is to pull out affected plants and burn them and dig lime into the soil. A virus disease, causing yellow edge and later smaller leaf, for which there is no remedy, reduces cropping capacity. Strawberry aphid and mite are insect pests.

Garcinia Mangostana. Mangosteen. (Guttiferae).

A small conical ornamental tree 6-9 metres high, very

slow in growth, with large leathery deep green leaves glistening in sunlight. Flowers are polygamous. The fruit is of the size of an orange, round and slightly flattened at each end, with a smooth thick rind of beautiful purplish rich red. The rind when removed, reveals a delicate snow-white juicy pulp—which is the part eaten—surrounding and adhering to the seed. The tree is a native of Malay Peninsula and Sunday Islands and is extremely limited in distribution. It is grown to some extent in Ceylon and in S. India,—only to a very limited extent on the lower slopes of Nilgiris and near Courtallum. The fruit is considered to be “the most delicious fruit of the tropics; delicately and finely flavoured”. Propagated from seed, from which it takes about 12 years to fruit. Secure 60 cms. high plants. Great difficulty is experienced in raising plants on account of the weak root system. Propagation by gootying is possible. It is a strictly tropical tree with its demands with regard to soil conditions also definite. Heavy loam with lot of soil moisture, and light shade throughout the life of the tree are essential. Suited only for a humid climate from sea-level to about 400 metres.

Mangifera indica. Mango. (*Anacardiaceae*). Vern. ‘Am’, ‘Manga’, ‘Mavu’.

An extremely popular tree, held sacred on account of its great uses. Mango is one of the choicest table fruits; it is “The King of Fruits”, “the apple of the tropics and a friend of the rich and the poor alike”. It is rich in vitamins A and C.

Indigenous to India, known from immemorial times and cultivated in every province. Hardy and remarkably tolerant of soil and climatic conditions. Grows and fruits from sea-level to about 1,500 metres. Known to grow and bear in places like Saharanpur in N. India where winter temperature comes down to 20° F and in places in S. India where the temperature rises up to 120°. For commercial planting, regions below an elevation of 1000 metres, not subject to severe winter conditions and free from frost and free from rain and cloudiness during the flowering period are best suited. Heavy rains, when in flower, wash off pollen and prevent fruit-setting. Flowering

commences from early November and extends to February and March, the exact period varying with the varieties themselves and the peculiar climatic conditions under which they are grown. The cropping season extends from the middle of March to June and even up to August. Flowers of the Mango are very small. Several hundreds of them are borne in huge panicles. Most of them are staminate. Only a very small fraction of the perfect flowers set fruit. In crop production, the Mango is erratic. Most of the varieties do not bear every year; some varieties do not fail to fruit every year.

Unless too water-logged or too alkaline or too rocky below, Mango is adaptable to a wide variety of soils. Deep, well drained, open rich soil is best suited as the roots travel far and deep. The tree grows to a height of 9 to 12 metres with a good spread and needs to be planted at least 12 to 13 metres apart in fertile soil. This spacing may be reduced to even 8 to 10 metres in poorer soils, or in the case of small growing varieties. For planting, large pits, $\frac{3}{4}$ metre deep, long and broad, should be made and filled at the bottom with the top soil mixed with plenty of farm-yard manure and 4.5 kg. of crushed bones or bonemeal. Planting is best done just before or just after the commencement of the rainy season. In S. India, planting season is from July to December. In places with heavy rain, getting more than about 150 cms., planting is deferred till the end of the rains. Young plants need regular watering during the first 3-4 years. They need manuring annually. Liberal quantity of cattle manure may be spread in the basins which should extend to a little beyond the outer spread of the branches. Groundnut cake may also be applied at the rate of $1\frac{1}{2}$ –2 kgs. per tree, as also wood ashes. No manuring is usually done after four years. The trees benefit by intercultivation or the growing of green manure crops as dhaincha, 'pilli-pesara' sun-hemp, horsegram or groundnut. Otherwise, the ground in between the trees should be ploughed at least twice a year, once when the rains commence and once after the rains. Pruning is confined to the removal of dead branches. The Indian Mistletoe (*Loranthus*), a parasitic plant (known in vern. as 'Banda', 'Bandarika') found growing on the trees should be removed.

There are numerous varieties of the Mango, differing in size, shape, colour and quality, etc. Inferior varieties have a certain turpentine smell, have a fibrous pulp and are sour. The best kinds are large in size, have a small seed and fibreless sweet pulp of fine flavour and have a thin rind and keep long. The naming of the varieties has not been standardised and so is much confused, the same varieties being called differently in different districts. More than 300 varieties are believed to exist. The following are select table varieties of S. India:—Badami (also known as Kader, Alphonso), Raspuri (known also as Peter, Nadusalai, Yerra Govao, Mulgoa, Ruman, Kalapad, Padiri, Bangenapalle (known also as Baneshan, Chappattal), Mundappa, Thothapuri (known also as Collector, Kilimukku, Bangalora, Sundershaw), Neelam. Himayuddin (also known as Himampasand), Jahangir and Alampur Beneshan are among the best of the table varieties which do not come into the market freely as they ought to. The first two are shy bearers. Suvarnarekha (also known as Swarnarekha, Sundari) is a good variety commercially grown in the Circars. Cowasji Patel of Bombay, Fazli of United Provinces, Langra, Baramasia, Gopal Bagh and Kishen Bagh of Bengal are also reported to be good varieties. Not all these varieties are equally productive and regular yielders and suited to all tracts. They have each preferences to certain regions and the grower should take some trouble and ascertain which of them he can grow with advantage in his place.

As seedlings take many years to bear and as one cannot be sure of the quality of the fruit of a seedling, grafts (enarched plants) from yielding trees selected for the quality and size of their fruits should be secured for planting. As the percentage of success of propagation is low by budding, grafting by approach is the universal method adopted by nurserymen.

The following are the more important pests of the Mango:—Hoppers (jassids). These are small wedge-shaped brown insects which with their nymphs suck the sap from the blossoms, causing them to shed or fail to set fruit. Control is difficult. Spraying twice at intervals of 10 days with fish-oil soap solution is reported to be effective.

(2) Large grubs of a beetle bore get into stems and branches, causing the bark to crack and very often death of the affected parts. The presence of the grub is indicated by saw-dust-like powder near the tree and pellets of excreta pushed through openings. They are killed by a wire pushed into the holes and if they are too deep inside, by plugging the holes with cotton soaked in chloroform creosote mixture. (3) A fruit fly lays eggs inside the fruits hatching into wriggling white maggots which eat into the pulp. This is a serious pest in some regions destroying entire crops. Only certain varieties and especially, late ones, are subject to this pest. There is no very effective remedy. Collection of affected fruits, especially the first ones, and their destruction is advocated for controlling the pest. (4) A giant mealy bug sucking the sap from leaves and young shoots causes severe set-back in growth, unless picked and destroyed when only a few. (5) Scale insects infesting leaves are easily controlled by spraying with fish-oil-resin soap solution.

Of the diseases, sooty mould caused by jassids and scale insects is remedied easily. Powdery mildew which occurs at about the same time as jassids is controlled by dusting with sulphur which helps to keep down the insects also.

Spraying and dusting with insecticides and fungicides may prove too costly to be tried with benefit on large trees and plantations. A good rain frees them from many of the ills.

Monstera deliciosa. (*Aroideae*).

See page 372, under *Philodendron pertusum*. The chief draw-back of the fruit is the disagreeable itching caused in the throat by the small spines which are attached to the inside portion of the fruit.

Morus species. Mulberry. (*Urticaceae*). Vern. 'Toot', 'Shaloot', Kamblipashyam'.

Mulberry is a plant primarily of the temperate zone. There are, however, many species which grow in warm zones. Grown commercially as bushes or as small standard trees for the leaves which serve as forage for silk worms in sericulture. There are several varieties coming under three species, *Morus indicus*, *alba*, or *nigra*. The fruits are edible

and are mostly oval, cylindric or longish, either purplish black or greenish yellow in colour. The tree variety bearing high class greenish yellow fruits may be grown in the home garden. Easily raised from cuttings, it grows without care. In winter, the tree may be cleared of overcrowding intertwining branches.

Musa sapientum. **M. paradisiaca.** **M. Cavendishii.**
Banana. **Plantain.** (*Scitamineae*). Vern. 'Kela', 'Bale'
 'Vashai'.

Who does not know the Banana or the Plantain in India, a great favourite and one of the most useful of plants. Classification of Bananas is very much confused. *Musa sapientum* generally includes edible varieties, used as ripe fruits. *Musa paradisiaca* generally includes kinds used raw for cooking. *Musa Cavendishii* is a dwarf form. *Musa textalis* includes kinds grown only for fibre got from the leaf-sheaths. Originally, the cooking varieties were known as Plantains, and the table varieties as Bananas. This distinction is arbitrary and is no longer in vogue.

Botanically, the Banana is an interesting plant. The true stem is the thick, underground rhizome which sends out one set of roots spreading horizontally in the top layers of the soil and another set down to a depth of about $1\frac{1}{2}$ metres. Buds in the rhizomes develop and push out of the soil as suckers, which are pseudo-stems, and grow from 2 to 9 metres high into large herbaceous plants. The pseudo-stems are made up of sheathing bases of leaves. The flowers are produced in a prolonged spike which bends over from the centre of the pseudo-stem. They are arranged in clusters alternating with succulent reddish scales which drop off when the fruit stalks develop, that is, when 'hands' are formed out of the clusters of flowers. The top clusters bear pistillate flowers and it is only these that form fruits. The staminate and the neutral flowers (in which neither the pistils nor stamens are well developed) are towards the end of the spike. The cultivated varieties of Banana are seedless.

Banana grows from Cape Comorin to several metres up the Himalayas, from sea-level up to an elevation of about 1,600 metres. It is essentially a tropical plant ; thrives best in

moist hot regions ; does not relish places with severe winter or where frosts occur. In arid regions, it may be grown if irrigated copiously. As it is quick-growing and is a gross feeder with thick and soft roots, the Banana thrives best in deep rich porous (open) alluvial soil. Open texture of soil, plenty of moisture and abundance of humus or manure in the soil are essentials for good crops. Though Banana tolerates a certain amount of wetness of soil, good drainage should be ensured. There are numerous varieties, the same variety being often called differently in different places. The following are among the best table varieties:—Rajabale = Chakrakeli, probably the sweetest ; Rasabale = Rasakeli = Rasa vashai ; Chandrabale = Sevvashai = Chenkadali, the red banana ; Sirumalai = Malai vashai, the hill type ; Poovan = Mysore = Lalvalechi of Bombay ; Kunnan, especially Thattila — and Then Kunnan of Malabar ; Puttabale = Mauritius = Basrai of Bombay ; Pachebale = Pacha nadan ; Yelakki bale of Mysore with small highly flavoured fruits ; Karpura vashai = Kapur of S. Kanara. The following are some of the superior imported varieties:—Gross Michel = Jamaica, immensely productive tall growing variety with heavy large bunches of fruits of high quality ; Cavendishii = Hawaii, a very dwarf variety with superior fruits ; Lady's Finger ; Mons Marie. Monthan = Kaye bale = Maduranga is the most favoured cooking variety. Nendran of Malabar is the next best, used mainly for making chips.

Propagation is from suckers, which are of two kinds:—(a) Water suckers and (b) Sword suckers. The former are thin, dwarf, with leaves broad and similar to those of the large leaves of the parent. The latter are vigorous, have a stout base tapering to the top, and possess very narrow in attractive leaves ; they form large leaves only after they are 1 metre high, and for planting, they are preferred to water suckers. Planting may be done at any time of the year excepting during winter. June-September is the most favoured period for planting in S. India. If planted during heavy rains, some of the weaker rooted suckers rot and are lost. Select suckers, which should be young and less than $\frac{3}{4}$ metre and not over grown, are separated with a sharp-edged

instrument with as little damage as possible to themselves and to the parent rhizome. It is usual to dry them for 2-3 days and top them $\frac{1}{2}$ to $\frac{3}{4}$ metres from the base and to trim neatly the damaged roots and parts of rhizome before planting. The distance for planting should vary according to the variety, the nature and fertility of the soil and facilities for irrigation. Dwarf varieties are planted $1\frac{1}{2}$ to 2 metres apart in rows $2\frac{1}{4}$ metres apart. Tall varieties are planted 4 to 5 metres apart in rows $2\frac{1}{2}$ to 4 metres apart. Pits measuring $\frac{3}{4}$ metre $\times$ $\frac{3}{4}$ metre $\times$ $\frac{3}{4}$ metre or trenches, $\frac{3}{4}$ metre deep and $\frac{1}{2}$ metre wide are made and filled only to a depth of $\frac{1}{3}$ to $\frac{1}{2}$ metre with the soft top soil mixed with a liberal quantity of cattle manure, leaf mould and wood ashes. The suckers are planted deep in the centre of the pits or trench, completely burying the rhizomes with about 5 cms. of the basal parts of the pseudo-stems and firming the soil all round them. After planting, the soil is soaked through with water. Watering is done thereafter once a week. Rooting takes place soon and the plants begin to grow rapidly. About 3 months after planting, the ground is cultivated deeply, heaping up the soil round the stems and sloping it away from them making channels 30 cms. deep and broad round the pits and 60 cms. away from the stems or 60-75 cms. away from the trenches, as the case may be. Frequent cultivation helps to keep the roots deeper down. Plantains greatly benefit by frequent applications of manure followed by copious watering. Before the first cultivation, a liberal quantity of farm-yard manure and wood ashes is spread on the soil and dug in. An application of 0.45 kg. of groundnut cake per tree would benefit the plants much. Further applications of manure may be made in the watering channel about 4 months later. Small doses of ammonium sulphate once in 3 months would also be beneficial. Numerous suckers are produced from the base of the plants forming clumps in course of time. Only one or two should be selected to remain with each tree to take its place after it finishes after fruiting. Otherwise, the bunch of fruit would be small. Unwanted suckers should be removed frequently as they come up, without allowing them to grow at the expense of the mother plant, with minimum damage to

the rhizome and its roots. Green leaves should not be cut if large bunches are desired. Dry leaves hanging down the sides of the plant are removed to keep them clean. The plantation should be sheltered from high winds. Propping up the stems of taller growing varieties to avoid them from breaking with bamboo or wooden poles is a common practice. The inflorescence is borne 7-15 months after planting according to the variety and the fruits would be ready for harvesting in another 3 months. After the fruits are set and the bunch is fully formed, the remaining cone-shaped part of the inflorescence from the heart of the bunch should be cut away. The flowers in this part are used as vegetable. Rarely are the fruits allowed to ripen on the trees. When the fruits are plump and fully developed and are still green, it is usual to cut the bunch with at least 25 cms. of stalk above the first fingers or hands. The bleeding cut end of the stalk, if smeared with vaseline or treated with melted paraffin, would not only protect the bunch from disease but also help to keep the fruits fresh longer and to ripen with more attractive colour. The pseudo-stem should be cut back clean to its base after harvesting. The core of the pseudo-stem is also used as vegetable, if free from fibre. Only certain varieties have a core free from much fibre.

Plantains in India are wonderfully free from diseases and insect pests. The dreaded Panama disease or Banana Wilt, for which there is no remedy, is uncommon here. Rarely, fruit-rot and anthracnose occur, for which spraying with Bordeaux mixture is advocated. Bunchy-top, a virus disease, is prevalent in some areas. Diseased plants should be eradicated and suckers from them should not be taken for propagation.

Nephelium Litchi. Litchi. (*Sapindaceae*).

A native of South China and commonly grown in Northern India. Grows to 6-9 metres high, with an ornamental round-topped head of glossy evergreen foliage. The fruits are borne in loose clusters at the ends of the branches, 10-20 or more in a cluster. They resemble Strawberries in appearance, are oval in shape, about 45 cms. long and 30-35 cms. in diameter, are green-yellow to deep rose in colour when fully

ripe. They consist of a hard brittle rind with a rough surface divided into small areas, a fleshy aril, which is free from the seed which it surrounds. In superior varieties, the aril is thick and the seed very small or absent. The edible part is the aril, which is white, firm, juicy, and pleasantly sub-acid in flavour. Fruits are best in the fresh state. The canned or preserved product is said to "resemble preserved Muscat grapes in flavour". The sun-dried fruits, known as "Litchi Nuts" in America, are somewhat like raisins. For drying, gather clusters of fruits with parts of stalks attached to them, as individual fruits removed from the bunches do not keep for more than 2-3 days.

The Litchi is best suited for a moist sub-tropical climate. It abhors frost in winter and dry heat in summer. It requires deep rich loamy soil, and plenty of moisture. It is capable of adapting itself to a variety of soils and drier climate in well irrigated areas. It has been tried to grow well in S. India also, from sea-level to an elevation of about 1,000 metres.

Secure layers or grafts of superior varieties as Mc. Lean's, Bedana', Rose-scented or Muzafferpore. These fruit in 4-5 years, while the seedlings may take 8-12 years or even-more. Seeds should be sown within a week after the fruits are removed from the tree, as they lose their viability very soon. Plant 9 metres apart. Feed the tree with liquid manure, when the fruits are set. Manure liberally every year. The only serious disease is the rust, which at times curls the leaves rendering them brown and thick. Cut away the diseased branchlets and burn them.

Passiflora edulis. The Passion-Fruit. See page 371.

Passiflora quadrangularis. Granadilla. See page 371.

Persea americana and **P. drymifolia.** Avocado Pear. Alligator Pear. Butter Fruit. (*Lauraceae*).

The Avocado is "one of the undeveloped sources of food which the tropics offer at the present day". The tree is being increasingly grown. It is a food in Central America; "four or five corn cakes, an avocado and a cup of coffee constitute the meal of an Indian in Guatemala." The fruit is noted for its nutritious properties, containing a comparatively

large percentage of proteins, mineral salts and vegetable oil or fat. In the form of a salad along with onion, lettuce, and other vegetables, it is much relished. It can be eaten by scooping out the flesh with a spoon, flavoured with salt and pepper or with sugar. The fruits vary in shape from round to pear-shaped or oval, in weight from 2-6 kgs., in colour from green to purplish black. The trees grow 6 to 7 metres high and bear 4-5 dozens in large fruited kinds and more, 200-300, in small fruited kinds.

Horticulturally, Avocadoes are divided into three races:—(1) The Mexican race (*P. drymifolia*); (2) the West Indian Race (*P. americana*) and (3) the Guatemalan race (also *P. americana*). In the first type, the skin of the fruit is thin and the leaves are anise-scented. This type is sub-tropical in requirements and thrives only from 800-1,600 metres above the sea. In the other two types, the leaves are not anise-scented and they differ in the thickness and texture of the skin of the fruits. The West Indian race is best suited for low elevations in the tropics. It thrives best in moist regions from 300-900 metres. Dry conditions are not suited for all the types. They all grow best in deep rich moist loam, with the water table near the surface.

Raise seedlings from seeds which should be sown fresh. As seedlings do not come true to parent, bud them when about 1.5 cms. thick with buds taken from a select tree. Plant the budded plants about 8 metres apart. Cut back terminal shoots. This encourages them to branch out and spread. A good spread helps to keep the soil below, cool and moist, which the trees want. Being rapid in growth, they are gross feeders and so dig in plenty of manure making the basins larger and larger as the trees spread out. Water liberally never allowing the soil to get dry. Mulch the soil in summer. As the roots are on the surface, do not cultivate the land deep. It is a hardy tree with very few pests.

Photinia (Eriobotrya) japonica. Loquat. Japanese Medlar. (*Rosaceae*).

A small evergreen tree about 8 metres high with an ornamental crown, normally compact and dense. Indigenous to

Central China and Japan. Does not fruit in the tropics below 450 metres. Thrives from 800 to 1,600 metres, being sub-tropical in its requirements. Frost is injurious. Flowers are borne in terminal panicles and are very fragrant. Fruits are in loose clusters, oval or round, 30-60 cms. long, pale yellow to light orange in colour. The skin, which is downy, surrounds the flesh which is firm, white or orange in colour, is juicy, sub-acid with a pleasant flavour. Seeds vary in number from 1-5 or more. Seedlings take 8-10 years to fruit. Secure gooties or layers or budded plants, which bear in 4 years.

Select a heavy well drained soil. Plant 8 to 9 metres apart. Water freely though the tree resists drought. Manure well, as the tree exhausts the soil soon. A low flat tree is desirable and so head back the branches once in 3 years after the main crop in February. The number of internal branches may with advantage be reduced to administer light and air.

Select varieties for United Provinces where it thrives well are :— Californian Advance, Tanaka, Golden Yellow, Thames Pride and Large Agra.

Phyllanthus distichus. Otaheite or Star-gooseberry. (*Euphorbiaceae*). Vern. 'Siru-nelli', 'Kirinalli'.

A small ornamental tree with long graceful branches and feathery leaves, bearing clusters of fruits from old wood. They are pale green, round and ribbed and acidic and are useful for pickling and for making a delicious preserve, cooked in sugar. They are also used for dessert purposes. Generally, two crops are borne in a year in April-May and August-September. Suited best to moist low country. Thrives up to elevations of about 1,000 metres. Raised from seeds. Planted 6 to 8 metres apart. Not commercially grown.

Phyllanthus Emblica. Amla. Indian Gooseberry. Vern. 'Amla', 'Nellikai'.

A small tree with graceful feathery foliage, native of India, Ceylon, Malaya etc., commonly found in tropical forests and hill slopes upto an elevation of about 1,250 metres. The fruits are round, of the size of a large marble, are green,

becoming light yellow or brick-red when mature. They have a thick acidulous kernel enclosing a seed. Amla is reputed for its life prolonging properties. It is very rich in natural vitamin C; fresh Amla juice contains according to Aykroyd 20 times as much vitamin as orange juice. The fruits are used for pickling and making 'morubba', a sweet preserve; Amalaka oil made by boiling the kernel in gingely oil is reputed to cool the brain and guard against or relieve nervous headaches; the powder made from dried kernel mixed with honey and taken internally in diabetic complaints relieves exhaustion. Propagation is from seed. The large fruited fibreless variety is favoured for planting in home gardens. Fruiting season is from November-January.

Physalis peruviana. Cape Gooseberry. Peruvian Cherry. See page 584.

Prunus armeniaca. Apricot. (*Rosaceae*). Vern. 'Shakkar Badam'.

A roundish fruit with smooth exterior about the size of a Rose-apple with a stone shaped like an Almond. The tree is suited only to a temperate climate and fruits, though not freely, only on hill stations. Grown in Baluchistan and Kashmir. Method of cultivation is the same as that of the Peach. It bears its fruits on young wood and hence an annual succession of young shoots should be aimed at by cutting back crowded and very old and ill shaped branches. Fruiting season is May-August. See also under Peach.

Prunus domestica and bokharensis. Plum. (*Rosaceae*).

Suited only for a temperate climate. Grown like the Peach. Fruits are borne both on spurs and young wood and hence pruning is lightly done, only clearing out the centre of the tree, reducing very old growths and removing only thin and useless branches and side growths. See also under Peach.

A few varieties are grown in N. India and at high elevations in South India as at Kotagiri, which is about 2,000 metres above sea-level. The trees spread to a diameter of 3 metres to about 4 metres or more and so the distance for planting would vary from $3\frac{1}{2}$ to 6 metres, according to the variety grown. The following varieties have been

tried with great success at Kotagiri (Nilgiris):—Kelsy and Shiro bear very large luscious dessert plums of a golden yellow colour. The trees spread ultimately to a diameter of about 6 metres and they are not prolific bearers. The October Purple bears purple skinned medium-sized fruits, which are good for cooking and eating. It is a late variety, coming into bearing long after other varieties. Rubio bears very heavy crops of dark skinned and fleshed plums, useful for cooking and making jams. Hale is red skinned and yellow fleshed, delightful for eating and used for cooking also. Alu Bokhara bears a very heavy crop of yellow plums which are good for eating, cooking and jam making. It spreads only to about 3 metres.

Prunus persica. Peach.

The Peach also thrives like the Plum and the Apricot only on hill stations. Grown on a large scale in North West Frontier Province and upland valleys of Baluchistan and in Kashmir and Punjab. Peach, Plum, Apricot as also the Apple and the Pear are a class of trees which are only suited for cultivation at higher elevations, some thriving and fruiting at comparatively lower elevations of about 800 metres than others. The Apple seems to require a lower elevation than others, the best fruits being produced at Bangalore with an elevation of about 1,000 metres. All these trees require a long enough period of rest, a long winter, for successful fruiting. At places where this does not obtain, the trees are artificially wintered as described in page 137 by withholding water to the roots and exposing them to the sun and even cutting back some of them when filling in the basins with fresh earth. Rainfall during the period of bloom prevents pollination and consequently setting of fruits. All the kinds mentioned above need full exposure to the sun and shelter from strong winds. The soil should be deep loam and should be well drained. They do not require copious watering except when the fruits are developing. Planting is best done during the cold weather. The plants establish by the time the rains set in. If planted during rains, they may suffer from collar rot and die. To prevent this, the

trees may be provided with collar pots, as stated in page 142. Reference may be made to pages 134 and 595 for pruning. The apple, in this country, takes very unkindly to pruning, the trees never recovering from the shock, refusing to grow after pruning and dying ultimately. All the above trees have almost the same common fungus and insect pests. A reference may be made to Chapter XI for remedies as occasion arises. Preventive spraying (see under Apple) with Bordeaux Mixture helps to keep them in check.

Peach bears fruits which are fleshy, health-giving and delicious. They have a large stone inside. The superior kinds bearing large and luscious 'melting' fruits cannot be grown in India, except on hill stations which do not get much rain. At medium elevations, only the 'Indore' variety thrives and fruits satisfactorily. Get layers from free fruiting trees or budded or grafted plants and these bear in two years. Seedlings take 4-5 years to fruit. Plant 4 to 6 metres apart. The trees make very vigorous growth of wood and foliage and hence for ripening the wood and to make the trees take rest and fruit well, they should be severely wintered. Wintering is best done for a period of a month in November or January. After wintering, the new shoots are cut back to two-thirds their length. Peaches bear on one year old stems. These are cut back to about 6 buds. Watering is sparingly done till the blooms appear. When the fruits set and are developing, watering is done liberally, and this is continued till the fruits ripen. Watering is discontinued thereafter. Trees less than three years should not be wintered. Peaches usually bear too many fruits for them to be able to bring all of them to maturity, as a result of which many drop off while yet young. To prevent this wastage, fruits while still very small are best thinned, keeping only one fruit for every 15 cms. of branch. On trees older than three years more fruits may be retained. Gummosis and leaf-rust are two common pests.

Psidium guava. Guava. (*Myrtaceae*). Vern. 'Pyra', 'Umrud', 'Koyya palam', 'Sebe hannu.'

Hardy large shrub or small tree, 4 to 6 metres high, growing without much care and attention. A native of Tropical America, naturalised in India. Fruits are round,

oval or pear-shaped in form, commonly yellow in colour, with pink or white flesh inside, in which are found several hard seeds. There are one or two varieties with very few seeds. In one particular variety, the seeds are 'paper shelled.' The flavour is sweet, musky and distinctive. Fruits are rich in vitamin C. They may be 'eaten out of hand' or made into a fine jelly or jam.

The Guava grows in tropical and sub-tropical regions under a variety of climatic conditions, from sea-level up to about 1,200 metres. It is tolerant of varying soil conditions also.

There are several varieties of local importance, due to propagation from seed. Latterly, superior varieties as 'Allahabad', 'Safeda', 'Karela' and 'Bangalore' are secured as layers or grafts for planting. The first two are large, round and white fleshed and of good flavour. The latter two are pear-shaped and also white-fleshed. All the four are suited for growing commercially. The 'Seedless' guava exists in round and irregular pear-shaped varieties and is not of any commercial importance, as it does not bear well.

Guavas are planted 4 to 6 metres apart, Fruiting is satisfactory, if the soil is good and of uniform texture to a depth of at least 1 metre. Though they are drought-resisting and grow without care, irrigation during the dry season and liberal application of farm yard manure during the commencement of the rainy season ensure good crops of fruits of large size. Guava is a heavy bearer and ripens its fruits over a long period. It bears two crops a year, in June-July and again in October-December. 500-700 fruits may be produced by a mature tree of about 8 years. In guava, fruits are produced on new shoots emerging from older wood. Cutting back the older branches once in 3-5 years in January after harvesting stimulates, production of fresh growth and so ensures a better crop during the next season. Common pests are scales and fruit fly.

Psidium cattleianum. The China Guava. The Strawberry Guava. A native of China, an ornamental shrub or small tree with glossy green leaves. The fruits are small, many seeded, only a 1.25 cms. in diameter, borne in plenty,

of a deep claret colour, and with flesh which is sweet and aromatic, palatable, soft and juicy. Can stand greater cold than the ordinary guava and is suited for medium elevations up to 1,200 metres. Very useful for making jam and jelly. Grown from seeds or layers. Planted 3 metres apart.

Punica granatum. Pomegranate. (*Lythraceae*). Vern.

Anar', 'Dalim', 'Madalam pasham', 'Dalimbare'.

Very popular hardy large shrub or small tree, 4 to 5 metres high a native of Persia, N. Africa and the Mediterranean region but known in this country from ancient times. It has enjoyed great popularity due to the medicinal properties of its parts and the healthful dietetic value of the fruits. The roots, seeds and the rind of the fruits are used in medicine for cough and bowel complaints. The juicy thick arils or pulp surrounding the many seeds is sweet with a delightful sub-acid flavour. A refreshing and cooling drink or squash or syrup is made out of it.

The Pomegranate is a sub-tropical plant. Fruits of high quality are obtained only from regions where there is a cool winter and a hot dry summer. But, it grows under a variety of climatic conditions throughout India, from sea-level to elevations of about 1,800 metres and can withstand considerable frost. Deciduous in places with cool winter, it is semi-deciduous or evergreen in other places. Though drought-resisting, it tolerates a certain degree of wetness in the soil and needs irrigation for bearing well. Though well adapted to diverse soil types, good fruits are, however, only obtained in deep heavy loam, in semi-arid regions where there is high temperature accompanying the ripening of the fruits which extends over a long period.

There are many types and varieties of local importance. The seedless Bedana and the Kabul and Kashmir varieties are the hall-mark of quality but they do not fruit in S. India. In the several varieties, the shape of the fruit is round, oblate or obovate; the size varies from that "of an apple to an infant's head"; the colour of the rind varies from pale yellow, orange-yellow to bright purplish red; in some varieties, the rind is very thick and tough, in some, comparatively thin; the arils in superior varieties are fleshy and thick and very

juicy enclose small soft seeds, whereas in inferior varieties, the seeds are large and hard and the arils thin; the colour of the aril varies from white (translucent) to pink and blood-red; the taste and flavour of the juice also varies from very sweet and perfumed to very sour. Sour varieties are used in medicine, though unfit for use as table fruits. In productivity also, the varieties differ. Varieties, known as 'Khaltus', 'Bassein Seedless', 'Madhugiri', 'Chintamani' are tried with great success in S. India. The last two are from Mysore.

Propagation, though possible from seeds, is best done by cuttings from select trees. The cuttings should be from mature wood, 20-30 cms. long and inserted so that only a third or less of their length is above the soil. Larger and sturdier plants are however secured by grafting or layering in a much shorter time. Seedlings may take 3-5 years to bear. Grafts and layers may produce fruits the very next year after planting. But, it is best the trees are well formed and make stocky growth during the first 2-3 years. For this purpose, plant them 30 to 45 cms. apart. Grow them to single stems up to a height of about 75 cms. Cut them back to 60 to 75 cms. from the level of the ground and out of the new shoots that start from the stems, retain 3-5 of the strongest well spaced and symmetrically placed ones. When these scaffolding branches have grown 1 metre, cut them back reducing them to about half their length. Allow only 2-3 shoots on each of the primary branches and remove the others. Thus pruned during the first 2 years, the trees grow into fine specimens with a strong framework. Thenceforward, pruning is only restricted to the removal of the sucker-like growths from the base, of the overcrowding and intertwining branches and of the dead and very old branches. The trees increase in size yearly and bear increasing crops. As Pomegranate bears fruits terminally on short growths or spurs produced on mature wood, with advancing age, the fruiting region goes up progressively higher and higher on the tree. When the tree becomes too tall for collecting the fruits easily, it may be renovated by cutting back the branches. A vigorous pruning of the branches results however is failure of the crop for a

year or two till the new shoots mature into bearing wood. Manure the trees annually and water once in 10-15 days. Fruits are produced thrice a year. They are large only if trees are allowed to fruit only once annually.

The commonest and the worst pest is the fruit-borer, which is the larva of the blue Anar or Pomegranate Butterfly, which lays eggs in the centre of the persistent calyx tube in the flowers of the setting fruit or young fruit. On hatching, the larvae or the caterpillars bore into the fruits and ruin them. If there are only one or two trees in a garden, it may be worthwhile to examine the flowers and small fruits and wipe off the eggs and if the eggs have hatched, remove the flowers and fruits too. Enclosing the young fruits in small cloth bags prevents attacks to some extent. The same bags may be used over and over again for about 2 years. The damage from this pest may be minimised by clipping away the protruding calyx cup or the blossom end of the fruits, when they are just set to prevent the fly from laying eggs there, a spot very much favoured by it. Spraying with good insecticide is also suggested as a precautionary measure. The infested fruits should all be collected and burnt. The adoption of the above methods of control should be helpful to eliminate the trouble from the pest in course of time.

Squirrels are very destructive and may, if unchecked, eat away an entire crop of fruits. Fruits are often enclosed in wire cages or tin cases perforated with small holes in home gardens to prevent damage by squirrels, birds and bats.

Spraying with Bordeaux mixture is recommended for a disease, which causes circular brownish tiny spots on fruits and leaves.

Pyrus communis. Pear. (*Rosaceae*).

The Pear thrives only on hill stations, at an elevation of 1,200 to 2,200 metres with a rainfall of 125 to 150 cms. The fruits produced at medium elevations are of inferior quality, are hard and not of the 'melting' type. The Pear prefers a light to a heavy soil and is grown like Apples. See page 638 also.

Pyrus malus. Apple. (*Rosaceae*).

A fruit of the temperate region and suited for hill

stations. See page 638-9. It requires a dry atmosphere when the blooms appear, a pretty long winter and an elevation of 1,000 to 1,500 metres for best results. Such conditions prevail in Kashmir and Punjab where Apples are commercially grown. Absence of a long and cool winter and high temperature during summer make it impossible to grow Apples in S. India, except at elevations higher than about 1,200 metres, as on Nilgiris, Shevroys and Palnis. Hardy varieties as Rome Beauty are suited for growing at slightly lower elevations of 800 to 1,100 metres. The climate of Bangalore is well suited for growing such Apples. Other varieties as Red Rome, Cleopatra, Ribston Pippin, Nonpareil, General Carrington, Cox's Orange Pippin, Jonathan are giving good results. In Bangalore, Apple-trees reach a height of about 3 metres and are grown in the form of bushes.

Before the second world war, thousands of plants were imported from Australia, budded on Northern Spy stock, which resists the blight which ruined many of the old apple orchards in and around Bangalore, some 30 years ago. Grafts are now made locally by grafting select scions on suckers taken from mature trees. Root-grafted plants yield excellent results and are easy to raise. One has to select thick large roots from a large tree, cut them into lengths of 15 cms. and whip-or side-graft them with healthy scions and insert them in soil for rooting. Apples are easily propagated by budding and budded plants are preferred to grafts. The best plan would be to plant Northern Spy suckers straight away, one each in the centre of prepared pits 3 to 4 metres apart and filled with rich red loam and bud them low down when ready. Perfect drainage of the soil is necessary. The first three years after planting are spent in the general shaping and building the plant by pruning and manuring twice a year and watering for good growth once a week during the dry season. The stems are enclosed in collar pots to prevent collar-rot. Irrigation is done in the basin outside the circular pot, so that the stem is not in contact with moist soil for any length of time. Collar pots are also helpful in keeping away termites, especially when filled with rough sand or left unfilled round the stem

from the level of the roots upwards. The ideal trees are those which have clean single stems up to a height of 45 to 60 cms. and then allowed to branch out to form a goblet formed bush.

In Bangalore, the Apple behaves more like an evergreen and so can be forced at will to produce fruits at any particular period of the year provided the flowers do not get washed out during the rains. They are forced to bear two crops annually—a practice probably confined and peculiar to Bangalore—by 'wintering' or artificially resting them to curb vegetative activity. Wintering is done in January-February when the plants are not active and in August-September when there is a break in the monsoon. Water is withheld from the plants for a fortnight. Soil is removed to a depth of 15 cms. in the basins corresponding to the spread of the roots, exposing the fibrous roots for 2-3 days. Root-suckers and damaged roots are clean cut off. Leaves drop and those which still persist are stripped off by running the hand close down the shoots from above. The fibrous roots are then covered with a thin layer of sand and then the basins are filled with a mixture of manure (preferably sheep manure), red earth and sand in the proportion of 3 : 2 : 1. A mixture of fertilisers made up of 2 parts of ammonium sulphate, 1 part of bonemeal, 1 part of super-phosphate and 1 part of potassium sulphate is also applied to the soil mixed with the compost at the rate of $1\frac{1}{2}$ kgs. for each tree. The soil is then firmed and copiously irrigated twice a week. Blossoms are produced freely in 15 days and fruits set in a month. In 2 months, they are of the size of a marble and become fit for harvesting in about 5 months. Thinning is done for fruits of large size. Water is gradually withheld till a week before picking. Time for picking is indicated by one or two sound fruits falling off of their own accord. Fruits have to be collected unbruised and kept in an airy place without touching each other. A 4-year old tree yields 4-5 and a six-year old tree 6-12 dozens of fruits annually. Thus treated, the plant lives for 10-12 years.

To keep the trees in healthy condition, it is necessary to spray them with Bordeaux mixture when they have been

wintered and stripped of their leaves, again when fresh leaves are formed and again when the fruits are set and are of the size of a marble. Spraying should not be done when the trees are in flower. Mildew, collar rot, rust, leaf spots are some of the diseases. Sun-scald is prevented by white washing the stem and branches. Stem-boring caterpillars and leaf-eating beetles are insect pests. For controlling these, refer to Chapter XI. The worst fungus disease at Bangalore is what is called "Silver Leaf disease". The spores are introduced through the wounds made in the stem by a flat grass hopper which has the same colour of the bark and which severely girdles it. The fungus first attacks the heart-wood which becomes brown and then it comes to the surface of the bark giving the characteristic black colour of sooty mould, as if burnt with a torch. The bark also splits and rots. This disease is very difficult to eradicate. Constant spraying with Bordeaux mixture and liberal feeding of the plant may do some good.

Rubus (sp?). The Wild Raspberry. (*Rosaceae*).

A straggling prickly bramble, which can be grown easily from medium to high elevation for hedging being armed with spines and bearing useful edible fruits. The old stems should be cut back for fresh healthy shoots which bear the flowers and the fruits. The stems are covered with a white down. The fruits are woolly in appearance, black-purple in colour, about 1.25 cms. long and broad, pleasantly flavoured, and eaten fresh or made into a jam, though they contain many small seeds. The plants respond to good treatment, thriving well in rich good soil, which is regularly watered. Propagation may be made by cuttings or layering. The easiest method of making large plants in a short time is by holding down the tips of the shoots in the soil which is kept moist. Soon, roots are emitted and shoots start from below, when the new plant is severed from the parent.

Spondias mangifera. (*Anacardeaceae*). Vern. 'Ammatekaye'. Medium-sized tree with handsome foliage. The fruits are oval-shaped and are of the size of a small hen's egg; the large seed in the centre is enclosed by highly acid fibrous pulp which has the flavour of the Mango. The fruits are used in preparing fish curries and pungent soups.

In the young stage, when they are soft and almost fibreless with undeveloped seed, they are pickled whole like tender mangoes. The tree grows without care. Suited best for moist low country. Raised from seed. Takes about 5 years to fruit.

Vitis vinifera. Grape. Grape-vine. (Ampelidaceae).
Vern. 'Draksha', 'Angur'.

Indigenous to S. Europe, Grape-vine is extensively cultivated there, in N. and S. Africa, Asia Minor, S. United States, Australia. Though considered a fruit of the temperate zone, it is grown in warm latitudes also. A hot and moist tropical climate is unsuited for successful cultivation. Warm dry weather from the time of flowering till the fruits develop is very essential, but during this period moisture should be supplied to roots by plentiful and regulated irrigation. Heavy rains cause the fruits to crack and decay and foster mildew and anthracnose diseases. Grape-vine can withstand frost when dormant but abhors very cold weather, when growing. In Afghanistan, Baluchistan, Sindh, Kashmir and Punjab, where a distinct and prolonged winter prevails, growth takes place in one season only in summer and hence only one crop is obtained annually. In other places in India where Grape-vine is grown as seen below, where there is no distinct winter or it is short and not severe, two crops can be raised annually successfully. With slight variations in all these places, the harvest seasons are March-May and August-December, according to when pruning is done. The pruning is done after a period of rest ranging from 15 days to 2 months after a harvest and is so adjusted that the flowering to harvesting period is over before the seasonal rains cause havoc. The first crop which is during the dry period of the year is sweet and plentiful and the second crop which is produced during a comparatively wet period is sour and not so good.

Grape-vine thrives best in deep well-drained light loam. Red loam with an admixture of gravel making the soil open-textured also gives good results. But in home gardens, where only one or two or only a few plants are grown, the nature of the soil is not of much consequence, provided good drainage is assured, as large pits measuring 1 x 1 x 1 metre are

made and filled with desired compost, rich in light loam, organic manure and crushed bones or bonemeal.

There are numerous varieties of Grape-vine, some particularly suited for making wine, some for drying to be converted to raisins and some for use as table varieties. The wine type is not grown anywhere in India except near Simla. Raisin types are grown near Quetta in Baluchistan, North West Frontier Province, Kashmir and Punjab. In other parts of India, only table varieties are grown. The following are select varieties commercially grown in the following areas:—

Baluchistan. — Near Quetta. Varieties:—Haitha ; Kishmish (the Sultana type known as Thompson's Seedless in white, red, and yellowish colours) ; Sahibi ; Fakri ; Hussani ; Tor.

N. W. F. P.—Near Peshawar. Varieties:—Bedana ; Tor ; Kishmish.

Kashmir.—Varieties:—Hussani ; Kishmish.

Punjab.—Varieties:—Muskat of Alexandria ; Sultana.

Bombay.—Near Poona and Nasik. Varieties:—Bhokari ; Fakdi ; Gulabi ; Pandari Sahibi ; Black Hamburg ; Gross Colman, Anab-E-Shahi.

Mysore.—Near Bangalore. Bangalore=Blue Black Aurangabad, Anab-E-Shahi.

Hyderabad. — Near Aurangabad. Varieties:—Black Aurangabad ; Bhokari, Anab-E-Shahi.

Madras.—Near Krishnagiri in Salem district. Variety:—Pacha draksha, a green sour variety.

Near Penukonda in Ananthapur district. Variety:—Bangalore Blue, Anab-E-Shahi.

At the foot of Kodaikanal hills in Madura district. Varieties:—Bedana, Sultana and Gulabi.

There are very many varieties from Russia and Mediterranean countries imported and grown in research stations. Their results are awaited.

It is to be observed that there is a wide range of varieties adapted for growing in the several parts of the country, each with its own peculiarities and degree of adaptation to peculiar climatic conditions. It may be possible to grow all varieties in all places in home gardens for at least one good crop.

annually by intelligent pruning to suit the particular variety at such a time that the flowering to fruiting period is not during the rainy season.

Grape-vine is mainly propagated by cuttings selected from mature wood of the previous season's growth, out of the prunings made in the dormant period for a next crop. Cuttings should be of the thickness of a pencil, 15 to 35 cms. long, with short inter-nodes. In about 4 months, they should be ready for planting. Some prefer to put down 3 cuttings in the centre of the pit and to retain the strongest and most vigorous plant for training. Grape-vine may be easily propagated by layering and large plants may be secured for immediate planting in a short time. In places where *Phylloxera* pest is prevalent (in India, Grape-vine are however free from this pest), only grafts of the susceptible variety on immune American stocks should be used. The pest is a plant louse which attacks the roots and kills the plants. Planting is done after the cold season is over. The distance apart for planting varies largely and mainly depends upon the method adopted for training the vine. They may be grown as bushes or short standards or grown as tall standards supported by tall stakes or stems of *Erythrina indica* tree, or they may be trained against the wires of a trellis, or grown over a pandal, arbour or bower.

Pruning is of the greatest importance in the cultivation of Grapes. In all methods of training, one strong shoot is elected for forming a stem or trunk of the vine and all others are rubbed away or cut off. The branches radiating from the top of the trunk which may be called the leaders form the framework. The fruit bearing area is close to the trunk on the leaders and to the leaders along the ripened shoots or canes of the past season emanating from them. Pruning consists in cutting back the mature ripened wood of the previous season or canes developed from the leaders, to one or more buds of their origin, that is, close to the leaders. Flowers and fruits are produced on the resulting new shoots in their basal regions. The short portions left at pruning time on the leaders are called spurs. The first bud or aggregate of buds attached to the leader remains usually dormant and does not break out into a shoot

or shoots after pruning. It is called the foundation spur. Others further up the cane left at pruning time are generally the fruiting spurs, from the shoots of which flowers are produced. The object of pruning is to concentrate the sap by pruning back the canes to the fruiting area of the plant. Some varieties of vine fruit only when short-pruned, that is, when the canes are cut back to 1-2 buds. Some others, fruit only when long-pruned, that is, to 4 to 6 or more buds. Most varieties seem to succeed with short-pruning. It is necessary, however, to get acquainted with the idiosyncrasy of each variety.

For growing on a pandal, which is the method adopted in S. India, planting is done 30 to 60 cms. apart, according to the vigour of the variety. The plant in each pit is grown to form a strong single stem by removing all side shoots and is allowed to reach a height of 45 to 60 cms. more than that of the pandal, which is generally $1\frac{1}{2}$ to 2 metres, when the tip of the stem is cut off to induce it to produce side shoots. 4-6 of these symmetrically placed ones are trailed off on the pandal radiating from the stem in different directions and the rest are removed. The shoots are tied up to the pandal with fibre and are grown as leaders, removing all side growths. When the leaders have travelled nearly three quarters of the length of the pandal they are cut back. Now onwards, side growths or laterals are encouraged on the leaders at definite intervals to form canes which cover the pandals. Thus the framework of the vine is established and thereafter, the canes from the leaders are short or long pruned, according to the variety, for fresh shoots, which usually produce flowers in 5-6 weeks after pruning. In about 4 months, fruits are ready for harvesting. As the shoots which bear one year will not fruit during the following season, they should be cut back for new shoots as before for the next crop.

In the trellis system of training, the trunk is allowed to grow to a height of 30 cms. after which it is allowed to branch out into 2 leaders, one on either side. These are tied to the wire horizontally and allowed to reach a distance of 1 to 2 metres. Strong shoots or laterals from the leaders are trained vertically along the wires. These shoots or canes

with the leaders form the basis for pruning. In the trellis system, the distance for planting may be $2\frac{1}{2}$ to 3 metres.

In Bombay, Grape-vine is grown as a standard about $1\frac{1}{2}$ metres tall. The vines are planted 2 to 3 metres apart in January. The leading shoot of the vine is encouraged to grow vigorously and reach a height of about $1\frac{3}{4}$ metres, by the advent of the monsoon. All side growths are removed from the growing stem. The shoot is pinched back to a height of $1\frac{1}{2}$ metres from the ground. Preserving the topmost 4 buds, all side growths arising from the trunk are rubbed off. Pangara (*Erythrina indica*) cutting, $1\frac{3}{4}$ metres length, is planted 20 cms. away on the leeward side to support each vine. The support takes root soon and becomes a live perpetual support to the standard trunk, with four or six branches or leaders radiating from its top, which form the basis for all pruning. In October, the canes are pruned back to 3-4 buds, the stubs left near the top end of the stem constituting the fruiting spur. The bud nearest the trunk remains ordinarily dormant and others from the spur break out into new shoots bearing clusters of fruits at their base, in the dry season. In April, after the harvest, all the shoots produced from the fruiting spur left in October are cut back to the first dormant bud near the trunk which is called the foundation spur. The foundation spurs of the vine may contain one bud or more than one compressed in the short space. The growths from these bear a few clusters of fruits at their bases which ripen in the monsoon period and are therefore sour. In October next, the canes of the April pruning are long pruned to 3-4 buds. Thus, the head of the vine or the area of fruiting increases every year. This method of backward and forward pruning for two crops a year may be adopted for different varieties in S. India also. The head of the Pangara support is pruned generally in April when the vine is pruned.

In the 'head-system' of training, the vine is grown to a single stem as in the tall standard system, the trunk being kept much shorter, from $\frac{1}{2}$ to 1 metre high. No staking of the stem is necessary after 4 years as it becomes stout enough to stand by itself. The head system is suited for varieties which make poor growth. Spacing for the plants may be $1\frac{1}{2}$ metre.

It is usual to winter Grape-vine as described in page 137, by withholding water before pruning, when it is resting after a crop. After wintering, the basin is manured liberally using sheep manure, failing which cattle manure, and copiously irrigated. No watering is done for the next 10 days. When the buds swell and the shoots grow out, watering is done more frequently, keeping the soil just moist always. When the fruits cease to develop in size and are about to ripen, watering is stopped. The basins are kept clean always by frequent weeding.

At the time of each pruning, the bark, wherever loose and may be taken off the vine without damaging the wood inside, is removed as it often harbours insects which damage the vine. Of the pests, the following are noteworthy: —(1) Cockchafer beetles. (2) Small fly-beetles. These eat buds, damage shoots and bite holes into leaves, causing substantial damage. They take shelter, under bundles of plaintain dry leaves torn into shreds and placed in the evening on the cut ends of the vine. The bundles are taken out carefully in the morning and burnt with the insects, (3) Vine-girdling beetles. Picked and killed. (4) Leaf-miners and leaf-rollers. (5) Grape-thrips. Dusting with sulphur for mildew kills the insects also. (6) Termites. Refer to Chapter XI for remedies.

Mildew and anthracnose are two serious fungus diseases of the Grape. Anthracnose affects all the green parts of the vine—leaves, shoots, blossoms and berries. Cankers or scars or produced on leaves and young shoots. Affected parts appear as if charred. Bird-eye spots are caused on berries, the centre being greyish and bordered by red-purple circular zone. Mildew and anthracnose are more prevalent in wet than in dry weather and are treated preventively by spraying with Bordeaux mixture soon after pruning and again when the shoots are growing and before they bear flowers. Thereafter, dusting with sulphur is done twice or thrice till the fruits ripen.

Ziziphus jujuba. Indian Plum. Jujube. (*Rhamnaceae*). Vern. 'Ber', 'Jujube', 'Elanda', 'Elachi'.

A small thorny spreading tree, commonly found all over India, especially in the hot dry zones. The wild varieties produce small round fruits. Improved varieties bear larger fruits, round or oval, there being two kinds; they contain a sweet and acidulous pulp which is relished by many. The tree is very hardy growing in any kind of soil, highly drought-resistant but found to grow even in moist sites.

There are several varieties of local importance, usually raised from seed. The seed is very hard and takes a very long time to germinate. Germination may be hastened by cracking the seed before sowing. Seedlings do not transplant well and so the seeds are best sown *in situ*. For commercial planting, it is usual to bud the seedlings grown *in situ* with scions from select large fruiting trees. Planting may be about 9 metres apart, as budded trees spread very much. The trees bear without much care or attention within three years of planting. Pruning is desirable to build the frame work of the tree, which would otherwise be scraggy and shapeless. The spreading branches bend greatly under the heavy load of fruits, 5,000 or more of them being produced by a full grown tree. Fruiting season varies from December-April.

The only serious pest is the fruit-fly which lays eggs beneath the surface of the skin of immature fruits. Within a week, the eggs hatch into maggots which feed on the pulp for 10-15 days and then emerge out of the fruit and drop to the ground, where they pupate in the top 8 cms. of soil. The only method of control is to rake the soil under the tree to a depth of 8 cms. to destroy the pupae.

CHAPTER XXXI

ROSES

Rose, the Queen of Flowers, is a hardy shrub, which can be grown with varying degrees of success in almost all places in India, from low country to the hill stations, where they thrive best. Roses vary much in their habit of growth, and it is easy to select kinds for several purposes in the garden, as for instance for covering walls and trellises, arbours, pergolas and arches, for massing in beds, for hedging and edging, for pot culture, and for growing as specimen plants.

Classification. There are thousands of varieties of roses. They are broadly separated into several well defined types or groups according to their origin and common characteristics such as habit of growth, season of flowering, shape of flower buds and flowers, their scent and colour. Catalogues of roses usually state the types to which the varieties listed belong. It is customary to classify the roses into modern types and the old fashioned roses.

The old fashioned roses comprises of Albas, Centifolias, the Damask and Moss roses, the Bouborns, Noisettes, Chinas, Teas as well as Hybrid Perpetuals. Except for the hybrid perpetuals chinas and Teas, the rest are more allied to species of rose.

The Hybrid Perpetuals are the results of the crosses between Damasks and recurrent chinas and Tea roses. These were the most favoured class of roses in the 19th and early 20th century. These are, as a class very vigorous, mostly self coloured and scented. In India, they are comparatively very shy bloomers and only a few varieties like Paul Neyron, Mrs. John Laing, Black Prince, Hugh Dickson and Frau Karl Druschy remain.

The Tea roses are, as a class, tender bushes with branching and spreading habit, producing the best of flowers on lateral shoots arising from the rods from the base. Flowers are characterised by delicate shades of colour, neat and attractive elongated form while in bud, and by sweet smell akin

to that emanating from a freshly opened tea-chest. Though not continuous bloomers, they are free flowering. These Tea roses for unexplained reason have suffered a similar fate as that of hybrid perpetuals. Only a few free flowering varieties like *Devoniensis* (creamy white), *Etoile de Lyon* (light yellow), *Madame Falcot* (apricot yellow), *Maman Cochet* (white and the pink), *Mrs. B. R. Cant* (deep rose), *Mrs. Herbert Stevens* (white) etc., are grown in many places but are no longer favourites.

The modern roses have been evolved by repeated crossing of the old varieties and the subsequent progeny and they fall mainly into two groups—the hybrid teas and floribundas (hybrid polyanthas). The hybrid teas were evolved by the crossing of the hybrid perpetuals and tea roses. They have characteristics intermediate between the parents. They are hardier than the teas and have much longer blooming period than the H. P. —qualities which make them good bedders. As a general rule the hybrid tea produces its large flowers one to a stem and the flowers are of very fine and exquisite shape, exhibiting the true spiral turn of the petals. They open slowly and are at their best in the $\frac{1}{3}$ to $\frac{1}{2}$ open stage. Then the centre is still pointed and held high. The pernetian roses have also been merged with the hybrid teas.

The floribunda roses of today were called the Hybrid polyanthas, as these were derived from the crossing of dwarf growing polyantha roses, which produce clusters of small flowers with varieties of hybrid teas. These produced semi-double or single flowers in clusters on taller plants and having larger petals and were very popular due to their hardiness and the ease of cultivation. By regular crossing of roses of such similar habit of flowering, the hybridists have evolved varieties that bear the flowers in clusters, larger in size, more vigorous in habit and easy to cultivate. These are termed as floribundas, which comprises all the bedding varieties of cluster flowering habit, excepting for the polyantha pompons due to their dwarfer habit and smaller bloom. There is another class called the polyantha compacta which are dwarfer than the polyantha pompons. The

floribunda roses are noted for their extreme hardiness and vigour and are unrivalled for massing and bold effect and for protective and ornamental hedges. The flowers are very long standing and repeat again and again almost althrough the year and have a wonderful range of colours.

As a result of crossing of the two very popular groups, the hybrid teas and floribundas, many varieties have emerged with fuller and larger blooms like the hybrid teas, but still having the cluster habit of flowering. These are named as grandifloras in America, but are called floribunda-hybrid tea type in other countries. Many such varieties are accepted as hybrid teas.

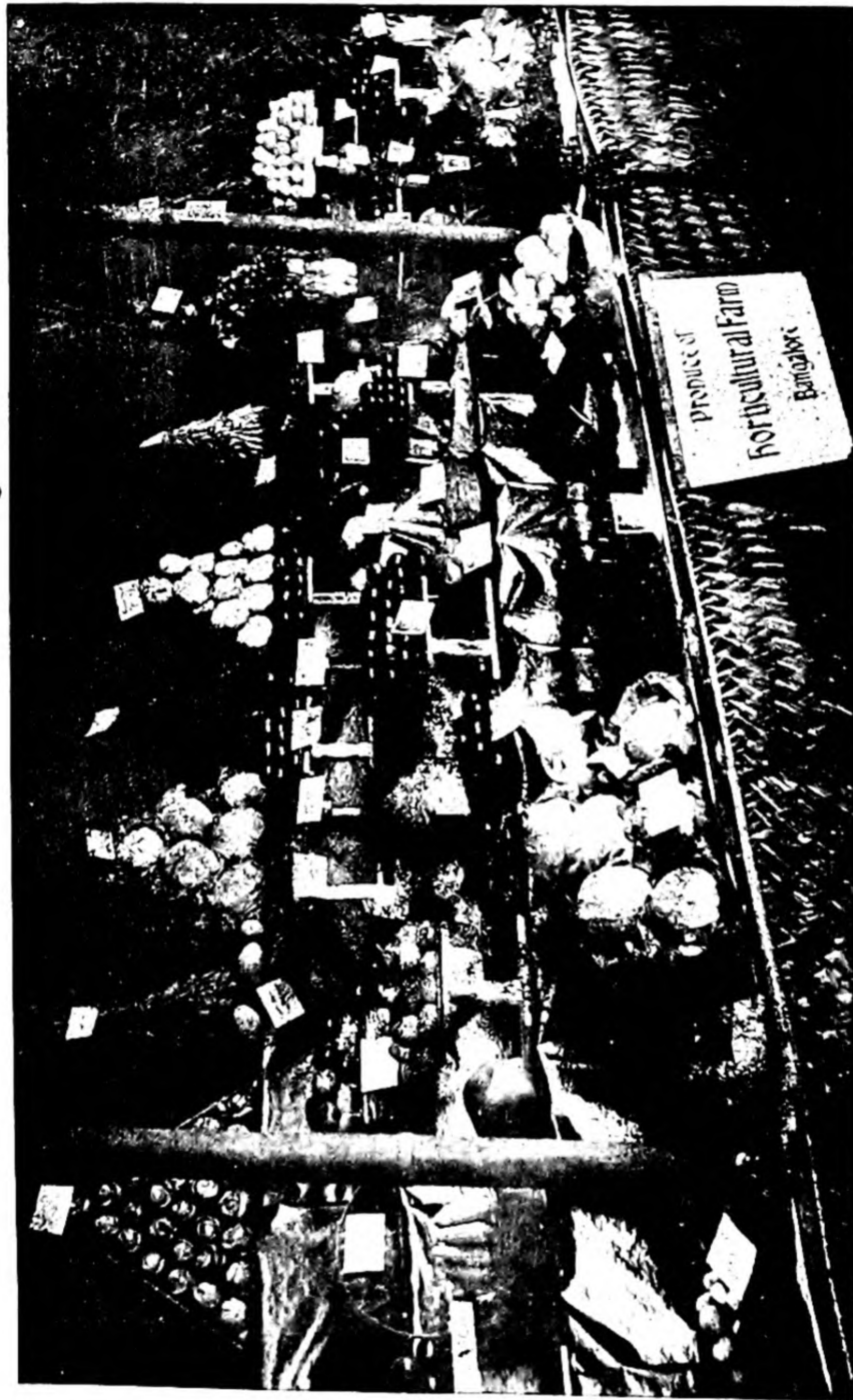
The other types of modern roses are climbers, ramblers shrubs and miniatures. The climbers are of upright climbing summer flowering, though a few varieties repeat. Some are sports of the dwarf types that is the climbing form of the hybrid teas, floribundas and polyanthas. These can be used to cover walls and for growing on trellis and fences. The ramblers are of rambling habit and bloom only in cooler places and hill stations. These are only summer flowering.

Miniature roses are getting extremely popular and no garden will be complete without them. They are ideal for rockery, window boxes, edges and for growing in pots. Except for their elfin size, these delightful roses are indistinguishable in perfection of form from large hybrid teas.

Climate. Roses, as a rule thrive best at places where there is a season of rest in winter and where the minimum temperature does not exceed about 50°. Roses do not dislike high temperature but they dislike places, where there is high temperature and excessive atmospheric humidity. In places of heavy rainfall good drainage should be assured.

Situation. The ideal site for a rose garden is one which receives the full benefit of the sun and sheltered from high winds and is free from the robbing roots near by.

Preparation of soil. Any good garden soil with good drainage will suit roses. If the soil is sandy it can be enriched by the addition of loam, organic manure like leaf mould and cattle manure. The heavy clay soil can be improvised by the addition of sand, turf, loam, and the organic manure to



COLLECTION OF VEGETABLES EXHIBITED IN A RURAL SHOW AT BANGALORE



WATER LILY (Nymphaea)

make it more loose and friable. A mixture of 3 parts of well decomposed horse or cattle manure, 2 parts of red earth and one part of sand will suit all types of roses. Deep cultivation is absolutely necessary as it ensures good drainage, aeration and allows the roots of rose trees to easily penetrate and the manure enriches the physical condition and fertility of the soil. In no case the sub-soil should be brought up and digging to a depth of at least 60 cms. is absolutely necessary. Good drainage will have to be ensured by putting gravel or crocks at the bottom. Prepare all rose beds at least three weeks before planting for consolidation.

Planting. Planting season varies in different localities but generally planted in cooler seasons, preferably from July to end of February.

Planting will have to be done during the cooler hours of the day. Open a hole in the prepared ground about 45 cms. square and 25 cms. deep and place the root of the plant in such a way that the budded union is above the soil. Spread the roots and work in round the rootlets some fine soil and a little bonemeal and firm it with hand to avoid air pockets beneath the roots, then cover with more soil and tread firmly. Root budded imported plants should be planted in such a way that the budded union is 4 to 5 cms. below the soil level. The plants budded or grafted higher should be planted to the level of the soil they were in the nursery. The planting should be firm. The standard roses are planted a metre apart and bush roses 45 cms. to 60 cms. apart in beds. Shrubs not less than one metre and climbing roses 2 metres and ramblers at 4 metres apart.

Transplanting. Transplanting of roses should be done in cooler months. Before transplanting all the foliage will have to be removed from the tree and then lifted from the ground. The excess roots are cut and all the twiggy growths and old and unwanted wood is pruned away and the other branches are shortened to $1/2$ to $1/3$ the growth and planted with the least delay.

For filling up of gaps in the old bed, it is very necessary to renew the soil, which has already exhausted by

removing of at least one cubic feet of soil and filling it up with fresh top soil from another part of the garden.

Watering and feeding. Newly planted roses are best watered to keep them just moist. The canes may also be sprinkled with water once or twice a day. Frequency of watering should depend on the climatic condition. During the summer and in hotter and windy regions watering may have to be done daily. Water the plant thoroughly. Surface moistening is injurious to the plant. Surface root growth encouraged due to insufficient watering will produce a weak plant, which is liable to perish during extremes of temperature. The general rule about watering is to keep the soil moist, not wet. The ground should neither be waterlogged nor dried to complete hardness.

Roses are gross feeders. During the growing period they must be fed with a complete fertiliser once a month. A handful applied to each established plant and watered thoroughly. This can be applied in conjunction with garden compost. People having easy access to well decomposed cattle or horse manure or good garden compost can mulch the beds with well rotted manure once a month. This slowly gets incorporated into the soil and works wonders. An extra feeding liquid form given from the time the buds form until the flower will produce large blooms. This is a favourite recipe of the confirmed exhibitors. This can be in the shape of quick acting chemicals—Nitrate of Potash and Phosphate of Potash at the rate of 30 grams each in 15 litres of water. Apply 5 litres of liquid to the square metre every five days during the flower forming period. Liquid manure made up of gingely, neem or castor oil cake is another alternative feeding. The oil cake is soaked in water for 4 or 5 days. While feeding dilute the solution to a pale straw colour and apply at the rate of 5 litres per plant. The general principle will be to feed small quantities at frequent intervals. During the drier months irrigate the plants before applying any fertiliser and the application is best stopped during the hot months. Newly planted trees require only a little of this extra feeding.

The following mixture recommended by the Royal National Rose Society of England is found extremely good and meets all the requirements of the rose :—

Nitrate of Potash	..	6 parts by weight.
Sulphate of Ammonia	..	3 parts „
Super Phosphate	..	16 parts „
Sulphate of Potash	..	8 parts „
Sulphate of Magnesium	..	2 parts „
Sulphate of Iron	..	$\frac{1}{2}$ part „

This mixture can be spread over the beds, one handful for square metre or can be applied as a liquid manure. This mixture is readily marketed by many fertiliser dealers.

Foliar Feeding. This is a very interesting phenomenon and it is now established that the plants can absorb the nutrients presented as a spray on the leaves. This gives wonderful results in a quicker time. The plant gets abundant and luxurious foliage producing good sized flowers at regular frequency. The mixture is made up of :

Urea	..	30 grams.
Ammonium Phosphate (Dibasic)	..	30 grams.
Potassium Phosphate (Dibasic)	..	30 grams.

Thirty grams of the above mixture is to be dissolved in 10 litres of water and 14 grams of liquid soap may be added as a spreader and sprayed on the plants once in 10 or 15 days. In no case the dosage should be exceeded. A little excess may scorch the leaves.

The trace elements namely magnesium, boron and iron can be sprayed by making a mixture of :

7 grams of Magnesium Sulphate.
7 grams of Ferrous Sulphate.
$3\frac{1}{2}$ grams of Borax.

Seven grams of the above mixture to be dissolved in 5 litres of water and sprayed every three months. Here again the dosage should not be exceeded.

The two mixtures of the foliar feeding should not be mixed as it will form a precipitate. They should be sprayed separately. Insecticide or fungicide can be added to any of the sprays and applied as a combined spray.

Spraying of Antibiotics-like Terramycin, Streptomycin and Vitamin B have been found to be very beneficial to the plants. This helps in the resistance to diseases and give a fine lustre to the leaves and good colour to the flowers and makes the shoots stronger. The recommended dosage being $\frac{1}{2}$ tablet of Berin and $\frac{1}{2}$ tablet of 50 mg. of terramycin soluble in ten litres of water and one vial of Streptomycin capsule is sufficient for 80 litres of water.

The mixing up of any foliar spray will be a bit tedious to start with. The trouble taken is negligible as the results will be amazing. There are proprietary preparations like RA-PID-GRO and WELGRO in foreign countries and these are used as foliar spray.

Frequent spraying of foliage with clear water keeps the leaves in healthy condition, free of all diseases.

Disbudding. Almost all the hybrid teas produce clusters of buds, the number depending upon individual variety. If all the buds are left to develop there will be a cluster of poor blooms. Hence it is advisable to remove all the buds excepting the central one to get the best possible bloom. With decorative types and the floribundas disbudding is done to avoid overcrowding. This should be done even when the buds are tiny and should be done carefully as the flower stems at this stage will be extremely brittle.

Wintering. To maintain them in a healthy and strong condition and to enable them to furnish large blooms in large numbers, roses should be wintered, manured and pruned twice a year or at least once a year. Wintering consists in withholding water from or curtailing its supply to the bush for a period of three to ten days according to the sun is severe or not and as the plant is young or old, the object being to force the sap to the roots from the weak shoots which have to be pruned away. The soil is removed to a depth of 15 to 20 cms. exposing some of the roots of the bush for a day or two if the leaves remain green even after withholding water. The leaves turn yellow and fall off and some of the weak shoots dry up. Care is to be taken however that the plant does not dry up due to drastic treatment. The soil is then

replaced with fresh compost and the bush watered copiously moistening the entire soil. In a few days, the sap rises up the plant, when it is ready to be pruned.

Pruning. The rose is a spreading shrub in which branches and shoots of previous year's growth, which have finished flowering are continually being weakened and replaced by strong new shoots which should be encouraged. Pruning of a rose consists, first, in the removal of all dead, weak, overcrowding or otherwise useless shoots and secondly, in the cutting back or shortening of the shoots that remain after the above said thinning-out process is completed.

As a general rule the plants will have period of reduced activity and another of increased growth. Pruning should be undertaken to take advantage of this transition. October will be the ideal time for pruning in almost all parts of our country. Some, however, prefer to prune with the advent of the first monsoon, in June, after their enforced period of rest in summer.

The pruning of the maiden plant should be hard the first year in order to force new growths from or near the union. The plant will not be having many shoots. It can be started by pruning away the thin undersized stems at their base. The plant will then consist of three or four well ripened stems, each of which can be pruned to an outward pointing eye 15 to 20 cms. from the union. The new stems that break out from these eyes and from the union will form the frame work of the plant in coming seasons.

A novice who is to try his hand pruning roses may start in the systematic manner. Cut out all dead wood, remove all weak and spindly growths, all worn out and exhausted wood and shoots especially at the centre which should be kept open to the influence of sun and air. In cutting away the branches and shoots, remove them clean to the base of the plant or to the point of their origin on the stem as the case may be. If too many shoots remain after the above mentioned thinning-out process, reduce the number keeping a few stronger ones. Cut back the new basal shoots to thirty to forty centimetres long. With this

done concentrate on thinning and pruning the growths from the older wood made the previous season. This growth will consists of sturdy laterals and the sub laterals which followed the first blooms. These sub laterals are removed and more sturdy laterals cut back to within three or four eyes of their origin. In subsequent years the new laterals from these eyes should be treated in the similar manner, so that the tree is uniformly and gradually built up in size.

The shortening of the stems should be done according to the habit of the growth of particular variety and the type to which the plant belongs. Each type of a rose—very often a variety too—has to be pruned a particular manner, which should be studied by experience. One general rule to remember is that the stronger the plant or shoot is, the less is the length of the selected shoots to be cut away. Conversely, the weaker a plant or shoot is, the severer the pruning is to be thus leaving only a few buds that have to come up later. Always cut back the shoots to a bud pointing outwards, so that the shoots that emerge from them do not cross or overcrowd the centre.

Hard pruning is not advocated for hotter places. Generally all yellow and bicolour roses require moderate pruning that is shortening of healthy wood to not more than one-third or half of previous years growth. The other varieties can be pruned to half to one-third. It is to be remembered that more roses are damaged or killed in this country by too severe pruning than due to want of adequate pruning. Floribundas require light pruning whereas the miniatures require removal of dead and weak wood and just the clipping of the top. For climbers all interlaced stems and old shoots have to be removed. Roses generally bloom in 35 to 60 days after pruning.

Thinning. The removal of damaged and surplus new growth after pruning in weeks to come should be a matter of routine.

Removal of suckers. In case of budded plants, occasionally suckers of wild stock appear below the budded portion and these will have to be removed as and when they appear, as

otherwise this growth will supersede the budded scion and ultimately ruining the plant.

Pot culture. Pot culture of roses is simple. Well established plants are gradually shifted to larger and larger pots as they grow till they are finally put into 40 cms. pots. The drainage should be perfect and the soil should be kept just moist always, without being overwatered. Once a year, at the time recommended above for annual pruning, the entire soil should be renewed, by removing the ball of earth from the pot, reducing its size after clean cutting back of a few of its roots, and then the plant should be put in the same pot after cleaning it well or in the new same sized pot and putting fresh crocks for drainage. In addition to this annual repotting the soil should be renewed at the top to a depth of about 15 cms. or more about six months after repotting. After each turn of bloom, the soil is advantageously top dressed to a depth of 5 cms. with rich compost consisting of three parts of manure and two parts of earth. Pots should be kept on stones or bricks to prevent grubs from entering them through the drain holes from the ground. The soil should be examined at least once in two months for grubs. After each such inspections for grubs, the soil should be well pressed down. Pot roses are only maintained in healthy condition by feeding them every fifteen days with liquid manure prepared from oil cake and with artificial manures in liquid form. If the surface soil is renewed every now and then, or is covered with mulch of half decomposed manure once a fortnight, there is no need to use any liquid manure at all.

Propagation. Roses may be propagated in variety of ways from seed, by cuttings, by layering, by budding and by grafting.

Propagation from seed is seldom resorted to except when new varieties are desired to be raised by crossing and hybridising. Very few varieties of roses produce seeds and the seeds germinate very slowly and irregularly. The seedlings, in their turn grow very slowly and take several months to flower.

Not all varieties of roses can be easily propagated from cuttings. Whereas most of the varieties cannot be grown

from cuttings, others as the briar, multiflora and the Edward easily strike root. Miniature and dwarf polyanthas strike roots very easily from cuttings. The percentage of success however, with a large number of varieties is small, for the trouble taken.

Layering is a satisfactory method of increasing roses. Both cutting and layered plant are called 'Plants on their own roots', as distinguished from budded or graft plants. Own root plants are preferred by many, especially by beginners in gardening, as they are not put to anxiety of having to remove suckers and shoots from the stocks of budded or graft plants, which come up freely and which, if not removed as they appear, would weaken and cause the death of the favoured scions. Cutting or layered plant, except those of weak growing varieties, thrive and bloom quite as well as budded or graft plants. But all varieties cannot be propagated as plants on their own roots.

Grafting and budding are less wasteful of the scion plants for propagation than layering. Grafting by approach (inarching) is the method commonly adopted. Graft plants are not so clean and healthy as budded plants. So, persons, who know budding, prefer to increase their stock of plants by budding, especially as by budding, a large number of plants can be raised than by grafting, as a single shoot of the favoured plant furnishes a number of scions for budding.

The commonest and the most successful method of budding is the shield method, described in pages 100-102.

There are three kinds of stocks, favoured for budding, the 'Multiflora', the 'Briar' and the 'Edward' stocks. The first is suited best for all places; the second is suited for hill stations and medium elevations and the third is also suited for all places. The plants budded on multiflora are long lived and make better plants.

For purposes of budding well rooted plants of the understock are planted 20 to 30 cms. apart in prepared ground, where they are allowed to grow and thinned to one strong shoot on which the scion is budded. When the bud has taken, the understock is topped above the point of union and the scion is allowed to grow. It forms a small head, and

when the plant is sufficiently well grown, it is lifted into a pot to be grown as a pot plant or planted out.

Mulching. This aspect is being dealt with separately as it forms one of the main factors in maintaining the health and good growth of the rose plants. 5 to 6 cms. of thick mulch of good farm yard manure or leaf manure or garden compost should be applied to the beds or pots once in a month or two. It gradually gets incorporated in the soil and work wonders. Weed and water the plants thoroughly before applying the mulch.

The mulching maintains steady moisture content of the soil, keeps down the weeds to a great extent and ensures steady feeding in addition protects the plants against Mildew and Blackspot, by maintaining the soil temperature and by the avoidance of rapid variation of moisture.

Insect pests. The following are the more common pests on rose :—(1) Rose Beetle. These attack the foliage after dark, eating the leaves and making holes in them. They should be caught with the help of a light when they feed on the plant. They are usually found in the under surface of the leaves. If they are picked for two or three nights consecutively, the trouble would cease for the season. But if they come in large numbers, or if the number of plants are more for hand picking, the plants can be best sprayed with a strong insecticide. The grubs of these beetles, the Cockshafer grubs, as they are called, feed on the roots and kill the plant soon, if not picked and destroyed. (2) There are other larvae and caterpillars that attack the foliage. See page 160 for remedy. (3) Borer and saw fly are kept away by smearing the cut surfaces with a splash of tar or white lead or by applying a paste of soil and cowdung mixed with little insecticide. (4) San Jhose scales attack the stem sticking to it like brown dots and patches. Rub the affected parts with paste of earth, cowdung and sulphur or good insecticide. Application of methylated spirit mixed with equal parts of water is also a good remedy. See also page 164. (5) For Aphis on shoots and flower buds, Thrips on shoots, leaves and flower buds, which causes the contortion of leaves and flower buds and the red spider mite see page 163. A spray of a good insecticide

preferably a systemic insecticide is a good remedy. (6) To keep the plants away from white ants, remove the soil at the bases of the plants and apply lime sulphur solution on the stem from the level of the roots to a little above the surface of the ground. If the bases of the plants are smeared with neem oil which para-dichlorobenzene is dissolved, the termites do not attack for about three months.

Diseases. The most common diseases affecting the rose plants are the mildew, Blackspot, rust and Die Back. The mildew appears in extreme change of weather. The signs of the mildew are the appearance of isolated spots of white mould on the leaves. This could be effectively controlled in the earlier stages by spraying of epsom salt (Magnesium Sulphate) or washing soda fifteen grams dissolved in 5 litres of water. Spraying of Bourdieuix mixture or any proprietary fungicide and spraying of wettable sulphur or dusting of sulphur is also a remedy.

Black spot is a deadlier disease and cannot be easily controlled. This usually occurs during the wet seasons. The onslaught will have to be prevented as there is no known remedy for this. Periodical feeding, good growth of plants and clean cultivation minimise the extent of damage. The affected portion will be the leaf and in extreme cases the entire plant gets defoliated and the disease is highly contagious. This makes the appearance usually on full grown leaves as black or purplish spots on the upper side of the leaf and it gradually enlarges and become roundish about one cm. across and ultimately spreads to the whole leaflet, which drops off. Picking of the affected leaf from the plants and burning them will minimise the attack. This disease can be controlled by spraying of a proprietary product called Captan (Flit 406) regularly every ten or fifteen days. This can be repeated weakly during wet seasons.

Rust disease on roses does not usually occur in our country. This can be prevented and controlled by spraying Bourdieuix mixture or any sulphur proprietary product.

Many plants are affected by dieback, which appears following the pruning, mostly on older plants. It usually starts from the pruned end and gets downwards. This can

be prevented to a certain extent by the application of cowdung paste on the cut portions. But a sure remedy is by the application of paste made up of 4 parts of copper carbonate, 4 parts of red lead and 5 parts of lin seed oil with traces of BHC and DDT.

To control these diseases and pests, it is always better to be on the safer side by spraying of the proprietary insecticides and fungicides. Prevention is always better and repeat the spraying every week or fortnight during the entire growing period.

Rose growing is not so complicated as it appears, if only the feeding, spraying and after care schedule are implicitly followed. Meet their demand for water, food and pest control and you will be rewarded with a colourful cycle of blooms.

The following is a comprehensive list of recommended varieties, in their respective colour groups, with their years of introduction.

White, Flush & Cream

Hybrid Teas: —

Ardelle '57	Memorium '61
Barbara Richards '30	Misty Morn '49
Burnaby '54	Mr. Stedfast '68
Caledonia '28	Mme. Jules Bouche '11
Chanderi '68	Mt. Shasta '63
Clarice Goodacre '16	Pascali '63
Dr. Homi Bhabha '67	Polly '27
Dresden '62	Premier Bal '50
Full Cream '59	Snow White '41
Garden Party '59	Sweet Afton '65
Grand Moghul '65	Tushar '60
Happy Wedding Bells '67	Virgo '47
John F. Kennedy '65	White Christmas '53
June Bride '60	White Knight (Message) '57
Kaiserine Auguste Viktoria 1891	White Prince '61
Matterhorn '66	White Queen '58
	Youki San '65

Floribundas :—

Dedication '68
 Dimples '67
 Iceberg '58
 Ice White '66
 Irene of Denmark '50
 Ivory Triumph '61
 Moon Raker '68
 Moonsprite '56
 Ruth Hewitt '63
 Saratoga '63
 Summer Frost '62
 Summer Snow '38
 Swapna '68
 Tiara '61
 White Boquet '56

Dwarf Polyanthas :—

Jeanny Soupert '13
 Katherina Zeimet 1901

Little Lady '67

Sneprinces '53

Miniatures :—

Cindrella '53
 Easter Morning '60
 Frosty '53
 Little Scotch '58
 Pixie '40
 Polka Dot '56
 Pour Toi '46
 Presumida '48
 Twinkles '54

Climbing & Shrub Roses :—

Climbing Prosperity '19
 Climbing Virgo '57
 Delhi White Pearl '63
 Sea Foam '65
 Swan Lake '68

Pale Yellow & Yellow**Hybrid Teas :—**

Ama Tsu Otome '63
 Belle Etoile '61
 Casanova '65
 Dorothy Peach '57
 Ebb Tide '62
 Farah '63
 Golcanda '68
 Grandpa Dickson '66
 Lemon Elegance '62
 Lemon Glow '64
 Lemon Spice '67
 McGredy's Yellow '33
 Mitzi '56

Pale Hands '65

Peace '42

San Diego '68

Supreme '65

Yellow Queen Elizebeth '64

Floribundas :—

Gold Strike '66

Rimosa '58

Stacey '65

Miniatures :—

Jackie '56

Jackie Climbing '57

Pixie Gold '61

Yellow Bantam '52

Bright and Golden Yellow

Hybrids Teas:—

Amarillo '62
 Arlene Francis '57
 Barbara '62
 Belle Blonde '55
 Buccanrer '53
 Canadiana '67
 Chateau La Salle '67
 Diana Menuhin '63
 Dr. A. J. Verhage '61
 Dries Verschuren '60
 Fantasia '46
 Fantastique '43
 Feudor '61
 Fred Howard '52
 Fred Streeter '55
 Gold Crown '60
 Gold Dot '68
 Golden Giant '61
 Golden Autumn '68
 Golden Masterpiece '54
 Golden Emerald '66
 Golden Salute '63
 Gold Glow '59
 Golden Sun '57
 Grisbi '56
 Isobel Harkness '57
 Kanakangi '68
 Kanchani '68
 Kabuki '68
 King's Ransom '61
 Lamplighter '58
 Lemon Chiffon '54
 Louksor '67
 Lowell Thomas '43
 Lydia '33
 Marcelle Gret '47

Mari Gold '55
 Marie L. Sandoz '67
 Mary Poppins '65
 McGredy's Sunset '37
 Mme Charles Sauvage '49
 Mme Marie Curie
 (Quebec) '44
 Monte Carlo '49
 Palmela's Choice '68
 Peer Gynt '68
 Raja Ram Mohan Roy '59
 Summer Sunshine '62
 Sun Valley '52
 Tawny Gold '51
 Town Crier '61
 Western Sun '65
 Venusic '66

Floribundas:—

Adeline Genée '67
 All Gold '56
 Arthur Bell '65
 Girl Scout '61
 Gold Cup '57
 Gold Gleam '66
 Golden Coronet '67
 Golden Garnette '60
 Golden Jewel '59
 Golden Lace '62
 Gold Marie '58
 Gold Shatz '64
 Glory of Ceylone '67
 Indian Gold '61
 Jan Spek '66
 Kerry Gold '67
 Norris Pratt '67
 Sahara '67
 Safari '66

Spanish Sun '68
 Starlet '57
 Travesti '67
 Yellow Hammer '56
 Yellow Cushion '68
 Yellow Pinnacchio '49

Miniatures :—

Baby Gold Star '40
 Bit O' Sunshine '56
 Josephine Wheatcroft '51
 Yellow Doll '60

Climbers and Shrubs :—

Casino '63
 Elegance '37
 Golden Showers '56
 Gold Quelle '64
 Gold Stern '65
 Marechal Neil 1864
 Paul's Lemon Pillar '55
 Royal Gold '57

Apricot, Buff, Amber and Brown Shades

Hybrid Teas :—

Anne Watkins '63
 Bronze Masterpiece '62
 Cannes Festival '51
 Champagne '62
 Chief Seattle '51
 Cynthia Brooke '43
 Diamond Jubilee '47
 Diorama '65
 Ethel Sanday '53
 Fantan '60
 Gertrude Gregory '57
 Glowing Sunset '33
 Gracious Lady '67
 Grand Mere Jenny '50
 Hawain Sunset '65
 Helen Traubel '51
 Mahina '52
 Mme Kriloff '44
 Moonlight Sonata '67
 Rose Bruford '62

Seneca Queen '65
 Silva '64
 Tahiti '49
 Vasar Centinnial '61
 Vatican '67
 Whisky '67

Floribundas :—

Amberlight '62
 Ambrosia '62
 Apricot Nector '65
 Brown Eyes '59
 Cafe '56
 Cognac '56
 Gold Topas '63
 Sir Lancelot '66
 Tom Brown '66
 Vesper '67

Dwarf Polyanthas :—

Sunshine '27

Miniatures :—

Baby Darling '64

Orange, Flame, Copper & Bronze

Hybrid Teas:—

Anvil Sparks '62
 Apricot Silk '65
 Beaute '54
 Bettina '53
 Chantre '58
 Cover Girl '60
 Halloween '63
 La Canadienne '68
 Lady Belper '48
 Lady Elgin (Thias) '57
 Lovre '66
 Lucky Piece '62
 Mediterranea '43
 Majorette '67
 Mojave '53
 Phyllis Lucas '61
 Shiralee '65
 Sutter's Gold '50
 Tanya '59
 Tapestry '58
 Thanks Giving '62
 Vienna Charm '63

Valencia '67

Floribundas:—

Anne Marie '68
 Attraktion '63
 Bengali '66
 Colisee '65
 Copper Pot '68
 Fairlight '66
 Fillete '66
 Florida Von Scharbeutz '57
 Golden Slippers '61
 Orange Sensation '61
 Princess Michiko '66
 Spanish Orange '66
 Temple Flame '62
 Wouburn Abbey '62
 Zambra '61
 Zorina '65

Climbers:—

Autumn Sunlight '65
 Copper Glow '40
 School Girl '64

Light Pink & Silvery Pink

Hybrid Teas:—

Bel Ange '53
 Blithe Spirit '64
 Carina '65
 Charm of Paris '65
 Confidence '51
 First Lady '65
 First Love '51
 Gavotte '63
 Gay Debutante '62
 High Esteem '61
 Honey Favourite '62

Jenny Fair '67
 Kamalini '63
 La France 1867
 La Jolla '54
 Lady Seton '66
 Lady Sylvia '26
 Legendry '62
 Lilac Rose '62
 Lucky Lady '67
 Marylene '66
 Michele Meilland '45
 Mignonne '64

Nobility '61
 Pastel '61
 Pink Spice '62
 President Maca '33
 Rod Stillman '56
 Rose Mary '66
 Royal Highness '62
 Silver Lining '59
 Suzon Lotthe '47
 Tickled Pink '63
 Versailles '67

Floribundas :—

Americas Junior Miss '64
 Anna Louisa '67
 Arakan '68
 Baby Sylvia '59
 Bridal Pink '68
 Chanelle '59
 Fashion '47
 Fashionette '55
 Folk Song '65
 Gay Princess '67
 Geisha '64

Herself '66
 Jubilant '67
 Pernille Poulsen '65
 Tiki '64
 Vera Dalton '60

Dwarf Polyanthas :—

Babette '68
 Baby Betty '29
 Coral Cluster '20
 Fresh Pink '64
 Jean Mermoz '37
 Little Princess '37
 Mrs. Joseph Heiss '43
 Pride of Hurst '26
 The Fairy '32

Miniatures :—

Perla De Montserrat '45
 Pixie Rose '61
 Rosmarin '63
 Silver Tips '61
 Sweet Fairy '46

Climbers & Shrubs :—

Clair Matin '63

Carmines to Deep Pink & Rose Pink & Salmon Pink

Hybrid Teas :—

Amareuse '67
 Arianna '68
 Astree '55
 Bacchus '51
 Ballet '58
 Beautiful Tavrada '66
 Belle of Punjab '65
 Bewitched '67
 Bonsoir '68
 Candy Stripe '64
 Capistrino '49
 Charlotte Armstrong '40

Cherry Pie '65
 Claire France '64
 Columbus Queen '62
 Dame Edith Helen '26
 Delhi Princess '63
 Diapason '66
 Dr. F. Debat '52
 Dr. A. Schweitzer '61
 Dorothy Anderson '40
 Duet '60
 Eden Rose '53
 Eiffel Tower '63
 Elaine '54

Gail Borden '57
 Grace De Monaco '56
 Guinevere '67
 June Park '58
 Juno '50
 Klementina '65
 Kordeş Perfecta Superior '63
 Marie Antoniette '68
 Madrigal '50
 Margaret '54
 Maria Callas '65
 Nazr E Nazar '68
 Paris Match '57
 Palmela Travers '66
 Percy Thrower '64
 Peter Frankenfeld '66
 Picture '32
 Pink Favourite '56
 Pink Lustre '57
 Pink Peace '60
 Pink Supreme '67
 President Radhakrishnan '63
 Prima Ballerina '57
 Prince of Denmark '65
 Queen Elizebeth '54
 Reg Willis '66
 Romantica '62
 Santa Fe '67
 Shannon '65
 Show Girl '47
 Sphinx '67
 Sir Winston Churchill '55
 Symphonie '51
 Tiffany '54
 Timothy Eaton '68
 Tyriana '63
 Viola '55
 Violinista Costa '36
 Viva Rose '67

Voex Bonheur '60
 Wendy Cussons '59
 Youth of the World '67
 Zakir Hussain '60

Floribundas:—

Anand Rao '60
 Beatrice '68
 Chamba Princess '67
 Chic '53
 Dearest '60
 Decapo '60
 Delhi Princess '63
 Early Bird '65
 Else Poulsen '24
 Frolic '63
 Gene Boerner '68
 Gentle '60
 Heaven Scent '68
 Kimona '63
 King Arthur '67
 Kolar Princess '66
 Love Token '64
 Paddy McGredy '62
 Panchu '66
 Papillion Rose '57
 Pink Parfait '62
 Pink Puff '67
 Plentiful '61
 Rekord Blüher '65
 Rose of Tralee '61
 Seventeen '59
 Stanza '67
 Tivoli '55
 Tombola '67
 Traumland '58

Dwarf Polyanthas:—

China Doll '46
 Gabrielle Privat '51
 Little Dorit '30

Maud E. Gladstone '26
 Pink Shower '68
 Sheelagh Baird '44
 Suzanne Turbat '19

Miniatures:—

Bobalink '59
 Candy Cane '58
 Dwarf Queen '57
 Fringette '64
 Humpty Dumpty '52
 Lady Ann '61
 Mimi '65
 Mona Ruth '59
 Perla De Alacada '44
 Rouletti

Simple Simon '55
 Tinke Bell '54
 Tiny Jill '62
 Westmont '58

Climbers & Shrubs:—

Aloha '49
 Bantry Bay '67
 Cherryade '61
 Clg. Kordes Perfecta '62
 Climbing Pinkie '52
 Etude '65
 Galway Bay '66
 Parade '53
 Pink Perpetue '65

Coral Salmon, Salmon Orange & Vermillion

Hybrid Teas:—

Bayadere '54
 Blessings '68
 Bond Street '65
 Brandenburg '65
 Camelot '63
 Cape Coral '64
 Caroline '55
 Coral Star '66
 Coral Salmon '66
 Cherry Brandy '65
 Comtesse Vendal '32
 Coral Princess '66
 Coral Sunset '65
 Duke of Windsor '68
 Even Song '63
 Femina '63
 Fernand Arles '49
 Floriade '62
 Hawaii '60
 Invitation '61

Manola '63
 Margot Fonteyn '64
 Mirage '66
 Mischief '62
 Montezuma '55
 Polly Perkins '67
 Polynesian Sunset '65
 Sierra Dawn '67
 South Seas '63
 Strawberry Blonde '66

Floribundas:—

Ann Wheatcroft '55
 Apsara '66
 Arabian Nights '63
 Ascot '62
 Azeez '63
 Bobby Lucas '67
 Border Coral '57
 Border Queen '51
 Celebration '61
 City of Leeds '66

Coral Queen Elizebeth '66
 Dany Robin '58
 Dominant '67
 Edith Martinelli '66
 Elizebeth of Glamis '64
 Fanfare '56
 Flamenco '60
 Happy Anniversary '60
 Irish Mist '67
 Jiminy Cricket '54
 Janet Fraser '67
 Joyfulness '63
 Miracle '62
 Mrs. Anne Boufays '62
 My Girl '63
 Nymph '53
 Orange Sweetheart '52
 Pagan Beauty '65
 Salmon Sprite '64
 Scented Air '65

Seista '65
 Spartan '55
 Tip top '64
 Tony Lander '58
 United Nations '49
 Vagabonde '62
 Vandome '68
 Viking '65
 Vogue '51
 W. I. Jubilee Rose '66

Dwarf Polyanthas :—

Cameo '32
 Margo Koster
 (Sun Beam) '31
 Orange Triumph '37
 Vetertag '59

Miniatures :—

Cri Cri '58
 Eleanor '60
 New Penny '62

Orange Scarlet, Orange Vermillion & Fiery Red

Hybrid Teas :—

Agena '66
 Anarkali '68
 Aruna '68
 Coloranja '64
 Constanza '66
 Deepak Rag '59
 Elida '66
 Feur Ball '65
 Jolie Madame '58
 Maman '63
 Marella '61
 Numero Un '61
 Ole '64
 Orange Delbard '61
 Orange Flame '64

Queen Fabiola '61
 Super Star '60

Floribundas :—

Ahoi '64
 Athos '65
 Castanet '60
 Celestial Star '65
 City of Belfast '68
 Diamont '62
 Dickson's Flame '58
 Doris Norman '58
 Excalibur '67
 Finale '64
 Floradora '44
 Fred Loads '68
 Gallant '68

Ginger '62
 Hurra '62
 John Church '64
 Korona '55
 Le Soliel '61
 Lys Assia '59
 Maria '65
 Maxim '61
 Orangeade '59
 Orange Cup '65
 Orange Rosette '63
 Orange Silk '68
 Percy Pilcher '61

Resolut '62
 Salmon Perfection '52
 Sarabande '57
 Zauberlehrling '63
Dwarf Polyanthas :—
 Gloria Mundi '29
 Golden Slamon Superior '29
 Paul Crampel '30
Miniatures :—
 Scarlet Gem '61
Climbers :—
 Climbing Superstar '64

Scarlet, Geranium and Signal Red

Hybrid Teas :—

Allegro '58
 Aztec '57
 Baccara '57
 Comancho '68
 Canasta '67
 Fragrant Cloud '63
 Gratitude '60
 Kalpana '68
 Lucy Cromphorn '63
 Princess '64
 Radar '53
 Simon Boliver '67
 Soraya '55
 War Dance '62

Floribundas :—

Aramis '64
 Cocorico '53
 Dorothy Wheatcroft '60
 Evelyn Fison '62
 Fidelio '64
 Firecrest '64
 Fire Queen '65
 Fusilier '57

Gartenfreude '61
 Hassan '63
 Heat Wave '60
 Independance '51
 Meteor '59
 Paprika '58
 Ritz '61
 Rodeo '60
 Signalfleur '60
 Siren '53
 Taora '68
 Zizi '63

Dwarf Polyanthas :—

Nurse Cavell '17
 Rufus '25

Miniatures :—

Coralin '55

Climbers & Shrubs :—

Belle De Orleans '58
 Bischofsstadt Padderborn '62
 Climbing Blaze '32
 Copenhagen '64
 Dense De Feu '56

Rose Red, Blood Red and Crimson Red

Hybrid Teas :—

- | | |
|------------------------|--------------------------|
| Americana '61 | Kaiserine Farah '65 |
| Anne D'Ornano '67 | Karl Herbet '50 |
| Beaute Spatiel '67 | Klaus Stortebeker '62 |
| Blackney's Red '67 | Konrad Adenaur '55 |
| Bob Hope '66 | Lady Helen Maglona '26 |
| Careless Love '55 | Lady Zia '59 |
| Champs Elysees '57 | Leonar De March '60 |
| Credo '66 | Liebstraum '68 |
| Christian Dior '58 | Lotte Gunthart '65 |
| Chrystler Imperial '52 | Mardi Gras '53 |
| Crimson Duke '66 | Milord '62 |
| Crimson Halo '64 | Miss Universe '56 |
| Criterion '66 | Mister Lincoln '64 |
| Dame De Cour '58 | Mme Louis Leperriere '51 |
| Devine '66 | Modern Times '56 |
| El Capitan '59 | New Style '62 |
| Ena Harkness '46 | New Yorker '47 |
| Ernest H. Morse '65 | Norman Hortnell '63 |
| Erotika '68 | Opera '50 |
| Escurial '66 | Princess Liliane '54 |
| Etoile De Hollande '19 | Red American Beauty '59 |
| Friedrich Schwartz '52 | Red Ensign '47 |
| Grand Amore '68 | Red Lion '66 |
| Grand Slam '63 | Red Queen '68 |
| Gruz An Berlin | Roeloff Buisman '64 |
| (Greetings) '63 | Rose Bowl '61 |
| Happiness '51 | Rose Dot '64 |
| Helena Schoen '63 | Roter Champagner '63 |
| Henkell Royal '64 | Royal Canadian '68 |
| Heroica '60 | Royal Velvet '59 |
| Herz As '63 | Rubaiyat '46 |
| Indian Chief '68 | Sabine '62 |
| Indiana '66 | San Antonio '67 |
| Jamaica '65 | St. Agaro '59 |
| James Gibson '28 | Swarthmore '65 |
| Jantsen Girl '62 | Tania Verstak '62 |
| | The Alamo '59 |

Tradition '66
 Velvet Times '66
 World's Fair Salute '64

Floribundas :—

Alain '48
 Alamein '63
 Bonfire of Artek '66
 Concerto '53
 Cresset '61
 Fear Naught '68
 Frensham '46
 Garnette Red '51
 Garnet Rose '53
 Gartenzauber '61
 John S. Armstrong '61
 Letkis '66
 Messastadt Hannover '62
 Mohican '61
 Olala '56
 Red Pinnacchio '47
 Rosemary Rose '54
 Sangria '66
 Sherry '60
 Strawberry Fair '66
 Tamango '67

Travemunde '68

Valentine '51

Dwarf Polyanthas :—

Border King
 Dick Koster Fulgens '40
 Flombayant '31
 Hollandia '30
 Locarno '26
 Red Triumph '56
 Rote Gabrielle Privat '40

Miniatures :—

Centinniel Miss '52
 Dian '57
 Granate '47
 Little Buckaroo '56
 Little Joker '58
 Lollipop '59
 Midget '41
 Mon Petit '47
 Oakington Ruby '33
 Prince Charming '53
 Robin '56
 Sparkie '57
 Tiny Jack '62

Dark Red & Velvety Red

Hybrid Teas :—

American Home '62
 Avon '61
 Big Ben '64
 Big Red '67
 Bonne Nuit '60
 Charles Mallerin '51
 Crimean Night '67
 Crimson Glory '35
 Dark Boy '65
 Der Krad '62

Divine '64
 Ellen Mary '63
 Heart Throb '63
 Kalima '63
 Kardinal '67
 Lancastrian '65
 Lovita '66
 Mirandy '45
 Nigrette '34
 Norita '67
 Oklahoma '65

Papa Meilland '63
 Papa Schnieder '63
 Pharaoh '67
 Rajendra Prasad
 Red Chief '67
 Red Devil '67
 Roundelay '54
 Scarlet Knight '66
 Sonja Horstmann '66
 Seventh Heaven '66
 Sibelius '58
 Weiner Walzer '65

Floribundas :—

Dankos Heart '66
 Dev Dasi '67
 Europeana '63
 Heinz Erhardt '62
 Lili Marlene '60

Marlena '64
 Nordia '68
 Pigmy Red '53
 Prinzessin Irrlieb '63
 Red Favourite '54
 Scania '65
 Tonnere '53

Dwarf Polyanthas :—

Eblouissant '18
 Ideal '21

Climbers & Shrubs :—

Don Juan '58
 Solo '56
 Sympathie '51
 Rotte Flame '68

Miniatures :—

Dwarf King '57
 Red Elf '49

Mauve & Lilac & Magenta

Hybrid Teas :—

Blue Diamond '64
 Blue Moon '64
 Claire De Lune '67
 Cologne Carnival '64
 Eminence '61
 Fontaine Bleau '67
 Godfrey Winn '68
 Grey Pearl '45
 Heaure Mauve '62
 Intermezzo '63
 Lady X '66
 Lavender Charm '65
 Orchid Masterpiece '60
 Saphir '65
 St. Exupery '65
 Silver Star '66
 Simone '57

Song of Paris '64
 Sterling Silver '57
 Violaine '68
 Violette Dot '63

Floribundas :—

Angel Face '68
 Africa Star '65
 Amy Vanderbilt '56
 Escapade '67
 Gletscher '55
 Lake Koma '68
 Lavendula '65
 Lavender Pinnacchio '48
 Lilac Charm '62
 Lilac Dawn '63
 Maud Cole '68
 Magenta '54
 Overture '60

Pigmy Lavender '61

Silver Charm '68

Tutu Mauve '63

Dwarf Polyanthas :—

Baby Farraux '24

Heinrich Karsch '27

Miniatures :—

Mr. Blue Bird '60

Purple Elf '63

Climbers & Shrubs :—

Royal Lavender '61

Bicolour Pinks, Bicolour Reds & Multicolours

Hybrid Teas :—

Akebono '65

Altesse '50

American Heritage '66

Angel Wings '58

Angkor '67

Apogee '66

Atlas '66

Bajazzo '63

Balinese '63

Beauty of Festival '68

Brasilia '68

Caramba '67

Chicaco Peace '62

Cleopatra '55

Colour Wonder '64

Condesa De Sestago '32

Coronado '60

Courtisan '67

Dr. Valois

Fascinating '66

Flaming Sunset '48

Fortyniner '49

Francine '63

Garvey '61

Godess '57

Granada '63

Grand Gala '56

Grand Opera '65

Hong Kong '62

Ideal Home '60

Inge Horstmann '64

Isabel Ortiz '62

Kiss of Fire

Konfetti '65

Kordes Perfecta '57

Kronenburg '65

Love Song '55

May Flower '58

Melrose '63

Mexicana '67

Miss Canada '66

Miss Ireland '61

Mme Dieudonne '49

Mme Rene Coty '55

My Choice '58

Parthenon '67

Piccadilly '66

Rina Herholdt '62

Rose Gaujard '57

Sabrina '60

Santa Teresa De Avila '61

Stella '60

Sultane '46

Suspense '60

Sweet Cherry '60

Teenager '58

Tourmaline '65

Trade Wind '65

Traviata '62

Tzigane '51
 Vision '67
 Warszawa '57
 Westminster '60
 Yvonne Caret '63

Floribundas :—

Acapulco '62
 Angela '57
 Antike '66
 Autumn Spray '64
 Banbridge '67
 Beaulieu Abbey '64
 Charleston '63
 Circus '56
 Circus Parade '63
 Colour Carnival '62
 Daily Sketch '61
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B I B L I O G R A P H Y

1. The Illustrated Dictionary of Gardening, Vols. I-IV by G. Nicolson.
2. Cassel's Dictionary of Gardening, Vols. I-II. Edited by W. P. Wright.
3. Standard Cyclopedia of Horticulture, Vols. I-III. Edited by L. H. Bailey.
4. Thompson's Gardener's Assistant, Vols. I-IV. Revised by Watson.
5. Commercial Gardening, Vols. I-IV. Edited by John Weathers.
6. Practical Gardening for Pleasure and Profit, Vol. I-III. Edited by Walter P. Wright.
7. Theory and Practice of Horticulture, Lindley.
8. Epitome of Gardening, Moore and Masters.
9. All about Gardening, Published by Ward Lock & Co.
10. The how to do it, Flower Gardening Book, Walter Brett.
11. Gardening, Cecil Bartlett.
12. The Flower Garden, T. W. Sanders.
13. Beautiful Gardens, How to make the most of them, W. P. Wright.
14. Small Gardens and how to make the most of them, Violet Burton Biddle.
15. Little Gardens and how to make the most of them, H. H. Thomas.
16. First Step in Gardening, W. P. Right & Edwarn Castle.
17. The Practical Garden Book, Hunn and Bailey.
18. Pictorial Practical Gardening, Walter P. Wright.
19. Beeton's Shilling Gardening, Published by Ward Lock & Co.
20. Garden Making L. H. Bailey.
21. Gardens in the Making, Walter H. Godfrey.
22. Landscape Gardening, F. A. Waugh.
23. Modern Garden Craft, Gresham Publishing Company Ltd., London.
24. The Australian Gardener, Leslie H. Brunning. Robertson & Mullens Ltd., Melbourne.

25. Gardening in India, Firminger, revised by Burns.
26. Gardening in the Tropics, G. M. Woodrow.
27. Tropical Gardening and Planting, H. F. Macmillan.
Macmillan & Co., Ltd., London.
28. Indian Amateur Gardener, Landolius.
29. Practical Gardening for Indian Amateurs, Barton West.
30. An Amateur in an Indian Garden, Percy Lancaster.
31. Flower Gardening in South India, B. S. Nirody.
32. Flowers and Gardens, Mrs. Temple Wright.
33. Botany, Coulter.
34. Handbook of Botany, Evans.
35. Botany, the Modern Study of Plants, M. C. Stopes.
36. Recent Advances in Plant Physiology, Barton Wright.
37. A. B. C. of Agrobiology, O. W. Willcox. W. W.
Norton & Company, New York.
38. Some South Indian Insect Pests and Animals of Im-
portance, T. Bainbridge Fletcher.
39. Indian Insect Pests, M. Lefroy.
40. Handbook of Economic Entomology for South India,
T. V. Ramakrishna Iyer. Printed by the Superin-
tendent of the Government Press, Madras.
41. Fungi and Disease in Plants, Butler.
42. Diseases of Crop-plants in the Lesser Antilles, W. Nowell.
Published by the Imperial Department of Agri-
culture by the West India Committee, Trinity
Square, London.
43. Some Beautiful Indian Trees, Blatter & Millard. Bom-
bay Natural History Society Publications.
44. Indian Trees. Brandis.
45. Guide to Rose Culture in the Bombay Presidency,
Patwardhan.
46. Rose Growing, J. N. Hart.
47. Rose Growing for Amateurs, H. H. Thomas.
48. Roses and how to grow them, Heineman.
49. Handbook of Pruning Roses, The National Rose Society,
England.
50. Palms of British India and Ceylon, Ethelbert Blatter.
Oxford University Press.

51. Succulent Plants, Jacobsen translated by Veera Higgins.
William & Norgate Ltd., London.
52. Cactii and other Succulents. W. T. Neale & H. E.
Neale. Meeching Rise Nurseries, Sussex.
53. Orchids, James O. Brien.
54. Orchids, Pamphlet published by The Mysore Horticul-
tural Society.
55. Vegetables and Flowers from seed, Sutton & Sons.
56. The Carnation Book, H. H. Thomas.
57. Bulb Growing for Amateurs. H. H. Thomas.
58. Cultivation of Bulbous Plants in India, K. S. Gopala-
swamiengar.
59. Manual of Tropical and Sub-Tropical Fruits, Popenoe.
60. Hints on Fruit Growing, H. E. V. Pickstone. H. E. V.
Pickstone & Brother Ltd., S. Africa.
61. Pruning Department of Agriculture, New South Wales.
62. South Indian Fruits and their culture, K. C. Naik.
P. Varadachary & Co., Madras.
63. Fruit Growing in India, W. B. Hayes, Kithabistan,
Allahabad.
64. Bulletins published by Agricultural Departments of
Madras, Bombay and Mysore. Also journals as
Gardener's Chronicle, Tropical Agriculturist,
Brooklyn Botanic Garden Leaflets.
65. Journals of The Royal Horticultural Society, London.
66. Rose Annuals Royal National Rose Society, England.
67. Rose Annuals of American Rose Society, U.S.A.
68. Exotica by Alfred Byrd Graf.
69. Modern Roses VI by Mc. Ferland.
70. The Rose in India by Dr. B. P. Pal.
71. Be Your Own Rose Expert. Dr. D. G. Hessayon & Harry
Wheatcroft.
72. The Pocket Encyclopaedia of Roses. H. Endland.
73. Monthly Bulletins of Rose Society of India.

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